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ABSTRACT

The final report describes a project investigating the utility of dynamic assessment in measuring the cognitive functioning and learning characteristics of children with specific learning disabilities. Subjects were 229 fourth and fifth grade children with 75 of these diagnosed as children with specific learning disabilities. Measures of cognitive ability and personality included: Raven's Coloured Progressive Matrices, Cattell's Culture Fair Test, Matching Familiar Figures Test, Harter's Perceived Competency Scale for Children, and Trail Making and Visual Search Tasks. For several of these measures, test administration included both a dynamic and a static version. The California Test of Basic Skills was used as a measure of school achievement. Results indicated: (1) subjects generally performed at a higher level of competence when a dynamic testing procedure was used; and (2) there were marked differences between students with learning disabilities and nonhandicapped children in their error rates, planning ability, and their perceived cognitive competence. Dynamic assessment is likely to be most useful for students with learning disabilities as it reveals a number of processing deficits that can be addressed in the classroom. (DB)

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DYNAMIC ASSESSMENT IN RELATION TO LEARNING CHARACTERISTICS AND TEACHING STRATEGIES FOR CHILDREN WITH SPECIFIC LEARNING DISABILITY

Jerry S. Carlson

University of California, Riverside

Final Report for the U. S. Department of Education

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FINAL REPORT CERTIFICATION FORM

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SUMMARY OF FINAL REPORT

Purpose:

The purpose of this project was to answer three interrelated questions about about the utility of dynamic assessment in measuring cognitive functioning and learning characteristics of children with specific learning disabilities. First, does the dynamic assessment approach yield information which is a more appropriate indicator of cognitive competence than that obtained by traditional, standard approaches based on static test theory? Second, why and for whom is the dynamic assessment approach effective? And third, for what reasons should dynamic assessment procedures be employed? The sample consisted of 229 fourth and fifth grade children, with 75 of these diagnosed as children with specific learning disabilities. Several measures of cognitive ability and personality were used: Raven's Coloured Progressive Matrices, Cattell's Culture Fair Test, Matching Familiar Figures Test, Harter's Perceived Competency Scale for Children, and Trail Making and Visual Search Tasks. For several of these measures, test administration included both a dynamic and a static version. In addition, the California Test of Basic Skills was used as a measure of school achievement.

Results:

The data obtained provided an affirmative answer to the first research question. Subjects generally performed at a higher level of competence when a dynamic testing procedure was employed. Regarding the second question, there were marked differences between students with learning disabilities and nonhandicapped children in their error rates, planning ability, and their perceived cognitive competence. The investigator concludes that dynamic assessment is likely to be most useful for students with learning disabilities as it reveals a number of processing deficits that could be addressed in the classroom.

Implications:

The findings from this project strongly suggest that a dynamic approach to assessing the cognitive abilities of children with learning disabilities leads to more accurate estimates of their abilities than static tests, and provides information about their cognitive processing deficits that should be useful to their teachers. This report is well-written and clearly describes an important investigation with implications for instructional testing and instructional practice. Project Officer recommends approval of this report.

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Dynamic Assessment in Relation to Learning Characteristics and Teaching Strategies for Children with Specific Learning Disability

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Preface

The following is a final report for U. S. Department of Education research grant 6008100426. The work was carried out in cooperation with the San Bernardino Unified School District. Thanks are due to the administrators, school psychologists, and teachers in the district for their help and cooperation. Special thanks are due to Dr. Neal Roberts, Superintendent of the District, Mr. Clarence R. Goodwin, Administrator for Special Schools and Programs, and Dr. Ruth Burkhardt, presently retired from the District, but who was the Coordinator of Psychological Services. The cooperation of all of those with whom we worked is deeply appreciated. The openness and helpful attitudes of the District's personnel made our work pleasurable. The greatest personal reward, of course, came from working directly with the children. They deserve the biggest thanks of all.

I also wish to express my gratitude to the research assistance of Caroline Hearn, Julie Furuto, Marcia Johnson, and Mark Jensen. They carried out their duties in exemplary manner. Mark Jensen deserves special thanks for his involvement as general coordinator of the project. He did an excellent job.

Chapter I

Introduction

1.0 Purpose

A significant concern of our era relates to the conceptualization of what constitutes appropriate assessment for purpose of educational programming. Broadening assessment approaches and processes will provide new options for restructuring assessment practices and improving instruction decisions. Hopefully, such changes in connection with the shift in placement and instructional decision-making as a result of due process and the Individualized Education Plan, will result in appropriate placement and more effective education for learning handicapped children. This study is primarily concerned with the conceptualization of appropriate assessment approaches for the child with "specific learning disability."

In previous years in California, children who had "specific learning disability" were identified as learning disabled and educationally handicapped. Educators were generally convinced that the rubric "learning disabilities" was a waste-basket category into which children were grouped who could not be placed in any other category. However, the definition of "specific learning disability" stipulated by PL 94-142 provides a new opportunity for educators and researchers who are interested in studying psychological processes and who have been studying appropriate assessment procedures for children who have a disorder in one or more of the basic psychological processes.

The following review provides the rationale for the research project. Recent research relevant to the rationale is presented.

1.1 Bases of Dynamic Testing

An assumption often made in assessment of cognitive functioning is that test scores obtained in the traditional, standardized manner serve as adequate estimates of the cognitive competence of the person or group of persons tested. The validity of the assumption is based on the notion that performance is a veridical measure of competence, and that the scores obtained by the classical (static) psychometric approach reflect a stable, perhaps immutable substance. This suggests that intraindividual variations in information processing, resulting primarily from intellectual and/or personality factors, play relatively unimportant roles in test outcome. The relationship between subject- and task-independent variables is ignored (cf. Detterman, 1979).

The static test approach and the assumption behind it has been challenged by several authors in different countries (Feuerstein, 1979; Guthke, 1977; Keogh, 1972; Mercer & Lewis, 1975; Schmidt, 1971). It is argued that testing procedures must be developed and applied which adequately take intraindividual variability into account and reduce the potential discrepancy between measured cognitive functioning and cognitive competence (Birch & Bortner, 1966). The goal is to ascertain to what extent and under what conditions modifiability can be affected. This calls for a dynamic testing approach, where

modifications in testing procedures can be analyzed as they affect performance levels and interact with sources of individual variation without diminishing predictive validity. In fact, if the goal of educational intervention is to bring about change, assessment through dynamic procedures, where modifiability is a goal, should lead to enhanced prediction of performance. This should occur when a "match" is made beetween the approaches used in assessment and curricular teaching strategies. In the dynamic assessment approach, variations in testing procedure can be built directly into the test situation itself (Carlson & Wiedl, 1979) or implemented through training outside of the actual testing (Feuerstein, 1979). The latter requires subsequent assessment of the effects of the training on a transfer test and is thereby more difficult for the practitioner to implement than the former approach. We favor the former, incorporating the modifications in the procedures into the testing situation, for pragmatic and methodological reasons. Pragmatically, it is convenient and directly applicable for use by psychological practitioners. Methodologically it avoids problems related to the measurement of change (Cronbach & Furby, 1979).

1.2 Summary of Empirical Studies

The empirical work summarized focuses on a series of studies relevant to the project.

1.2.1 Testing Conditions Leading to Increased Levels of Performance

First, several types of commonly used variables were isolated which can be incorporated into testing procedures and be independently

manipulated (Carlson & Wiedl, 1976; Carlson & Wiedl, 1979; Wiedl & Carlson, 1977).

The testing procedures isolated different techniques of optimizing cognitive functioning. thus, controlled comparison between types of approaches often used, but heretofore not systematically analyzed in the dynamic testing approach, was made. The dependent measure was the Raven Coloured Progressive Matrices (CPM), a test of nonverbal intelligence (Raven, 1976). The CPM was chosen as it is considered to be a relatively "culture fair" test and a good measure of general intelligence. The subjects tested were 434 second- and fourth-grade chidlren from the general population. The testing conditions (C) employed were:

C_1. Standard Instruction, according to the procedures outlined by Raven.

C_2. Verbalization During and After Solution, which requires the child to describe the main stimulus pattern prior to searching for the correct distractor and then, after a particular distractor is chosen, to explain why he made the choice he did.

C_3. Verbalization After Solution, which involves the child describing the reasons for his choice after the choice is made.

C_4. Simple Feedback, where the child is informed only if he is correct or incorrect after his choice.

C_5. Elaborated Feedback, which involves, in addition to simple feedback, an elaboration by the experimenter of the reasons why the chosen distractor was correct or incorrect. The principles involved in the tas were pointed out.

C_6. Elaborated Feedbacl plus Verbalization During and After Solution, which is a combination of Conditions two and five. That is, it involves the child's verbalization of the pattern to be completed, followed by solution and the child's explanation for the reasons for solution, and elaborated feedback by the experimenter informing the child of the correctness of his response and explaining the principles involved in the task.

In all cases the child's initial response regardless of condition, was scored.

For the second-grade children, Conditions 2, 5, and 6 led to higher levels of performance than were found for Conditions 1, 2, and 4. The most effective conditions were 5 and 6. For the fourth-grade children, Conditions 2 and 6 led to improved performance. A trend in this direction was noted under Condition 5. Thus, three conditions for younger children and two procedures for older children were found which appeared useful for improving test scores, i.e., bringing performance closer to actual competence.

Beyond ascertaining the main effects of the testing conditions on total score CPM performance, closer analysis of the results was obtained by analyzing the interactive effects of performance with differentiations which the CPM allows in administration and scoring. The test can be administered in either the normal booklet form or in a puzzle, board-form version. In the former, covert processes must be used by the subject as he searches for solution. In the latter, overt trial and error procedures can be used. In soring the CPM, three

distinct subgroupings of items can be used. These were distinguished through factor analysis in a previous study (Wiedl & Carlson, 1976; see also Carlson & Jensen, 1980). The factors isolated were: simple pattern completion, pattern completion through closure, and reasoning by analogy.

Results of analysis of these differentiations showed that the puzzle version led to higher levels of performance for the second-grade but not the fourth-grade children. The salient item groups were simple pattern completion and pattern completion through closure. The effects of the optimizing testing conditions could be traced mainly to those items requiring abstract thinking.

On the basis of these results, two types of studies were conducted. In one type, the goal was to replicate and extend the above findings by investigating whether or not the salient testing conditions have the effect of optimizing performance for children from special populations. In the other type, in addition to extending general applicability, the goal was to assess the compensatory effect which the procedures could have in reducing differences between particular groups of children.

1.2.2 Children with Learning Difficulties

In a first study involving learning handicapped children (Carlson & Wiedl, 1978), the same testing paradigm as described for the first study was used. In addition, however, the test was readministered under C_1 to all subjects after a two-week interval. The sample consisted of 108 special school children, mean age 10.5 years, mean

WISC-IQ 70.8. Main effect differences were found for testing condition and repeated testing. Conditions 2, 5, and 6 led to higher performance than found under the other conditions. No testing condition by repeated testing interaction was found. The results are very similar to those obtained with children of average IQ, adding further evidence for the effectiveness of the salient conditions.

In addition to the main effect found for testing condition, a main effect due to test form (booklet-puzzle) was detected, with performance on the puzzle-form being higher than on the booklet-form. Further, it was evident that for the puzzle version of the test Conditions 5 and 6, but no Condition 2, were effective.

Localization of the effects to the subparts of the CPM revealed that testing conditions affected performance on the reasoning items only. Conditions 5 and 6 proved to be the most salient conditions. The effect of the board-form could be localized to pattern completion and gestalt closure items.

In another study (Wiedl & Carlson, 1981) designed to replicate and extend the results just described, 134 learning handicapped, special school children (mean age 10.10 years) were tested with the picture and puzzle versions of the CPM. Conditions 1, 2, 5, and 6 were used. The first testing was followed two weeks later by a second testing under the standard condition (C_1). Level of intelligence of the children was assessed by the Cattell Culture Fair Intelligence Test and used as a moderator variable. One-half of the children were assigned to a higher intelligence group (mean IQ 90), the other half

to a lower intelligence group (mean IQ 70). Age was used as a covariate.

A mean effect due to testing condition was revealed. Further analysis showed, however, that verbalization during and after solution (C_2) did not lead to higher performance. The condition involving elaborated feedback (C_5) tended to be effective and the condition combining elaborated feedback with verbalization (C_6) improved scores. Thus a differentition of results from the first study involving children with learning difficulties was indicated. On the other hand, replication of the findings was obtained concerning C_6. The results concerning the specific item types and test repetition were also replicated. In addition, and as expected, differences were detected for level of IQ; children in the higher IQ group performing better than those with lower IQ. The conditions which were effective in increasing performance were the same for both groups as no interactions between IQ level and testing condition was detected.

Beyond the differentiation obtained for the verbalization condition (C_2) and for elaborated feedback (C_5), a result different from that in the first study concerned the effect of repeated testing. A strong interaction was detected between testing condition and the first and second testing. Only Conditions 1 and 5 led to increased levels of performance on the second testing. Analysis of repeated testing on the subtests of the CPM showed that the effect for C_1 could be traced to improved performance for the perceptual items only. On the other hand, it was found that when the first testing was

administered under C_5, increased performance on the second testing also was obtained for items involving abstract reasoning.

In summary, the two investigations with learning handicapped, low IQ subjects show that testing procedures C_5 and C_6 are appropriate for use with these children. A restriction to the applicability of C_5 should be noted, however, as this condition was effective only with repeated testing. The effects could be demonstrated for items requiring abstract reasoning. This result is of special significance as the requirements of tasks of logical thinking are particularly difficult for children who have specific learning disability. It was shown that the effect of test repetition was not uniform; rather, it was related to the condition involved in the first testing and the type of item involved. For diagnostic purposes it would seem that second testing is valuable only when the first testing is administered under conditions of elaborated feedback (C_5).

The most important results described in the preceding section are summarized in Table 1, on the following page.

1.2.3 Personality and Cognitive Style Variables

The above presentation of the dynamic assessment approach has been concerned primarily with the validation of the assessment procedure in relation to the child who has a learning disability in basic psychological processing. In addition, however, it is proposed that it is important to investigate the learning (personality) characteristics of the child with specific learning disability. Moreover, it is important to establish how psychological processes interact with the learning (personality) variables.

Table 1

Summary of Salient Testing Conditions with Different Groups of Subjects

Groups of Subjects	Testing Conditions: Differentiated C_2 Verbalization				Elaborated C_5 Feedback				Verbalization C_2 + C_5 + Feedback				Board-Form			
	Item Requirements ++ T	p	c	r	T	p	c	r	T	p	c	r	T	p	c	r
Regular School																
Children 2nd grade	o		o		●		●		●		●		●	●	●	
4th grade	●		●						●		●					
Children with Learning Difficulties (avg. 4th grade)					o		o		●		●		●	●	●	

\+ o = slight
● = marked

++ T = total test score
p = pattern completion items
c = closure items
r = reasoning items

The educational research literature is replete with personality descriptions of the child who has specific learning disability and such conditions as perceptual handicaps, brain injury and minimal brain dysfunction (Cruickshank, 1972; Hallahan & Cruickshank, 1973; Hammill & Larsen, 1974; Hewett & Forness, 1977; Keogh, 1971; Keogh & Margolis, 1976). Among those characteristics most often implicated are: impulsivity, attention, anxiety, and motivation. A few examples may suffice: Campbell, Douglas, and Morgenstern (1971) stated that a child who is having difficulty in paying attention and learning to read may be diagnosed as minimally brain damaged, or learning disabled, depending on the bias of the diagnostician. A child who is distractible and overactive is often assumed to have perceptual-motor problems (Clements & Peters, 1962). Similarly (although the study was based on a sample of only four children), children who have learning disabilities are assumed to be impulsive and inattentive (Hallahan, Kauffman, & Ball, 1973). The debilitating effects of anxiety have been found to be greatest in evaluative situations and difficult tasks which are described as important (Bush & Dweck, 1975). It has also been suggested that learning disabled children are not motivated to achieve because of established failure sets (Hewett & Forness, 1976).

Unfortunately, researchers have too often established what characteristics the child displays and conjectured how they might influence assessment and learning without establishing an empirical base for the conjectured interactions (Pelzer, 1979). If an education

plan is to be designed based on appropriate assessment for the child with specific learning disability, the interaction between disorders in psychological processes (dynamic assessment) and educationally relevant personality characteristics (impulsivity, attention, anxiety, and motivation) has to be established.

Three studies have stressed the interaction of learning and personality characteristics of non learning disabled children. Bush and Dweck (1975) have concluded that task demands influence strategies children use who display reflective information processing while impulsive children seem to be unaware of the strategies they should match with the demand of the task. The other studies related the dynamic assessment approach to impulsive children (Wiedl, 1979; Wiedl & Bethge, 1980).

The main hypothesis of the first Wiedl study was that performance of impulsives could be made equal to that of reflectives by modified, more appropriate testing procedures. The subjects were 150 second-grade children, average age 7.6 years. The Matching Familiar Figures test (MFF) was administered to all children to assess degree of impulsivity-reflectivity. Based on their MFF performance the subjects were divided into two groups; impulsives or reflectives. The classification was obtained by mediansplit on the error score of the test. The CPM was administered under testing Conditions 1, 2, 5, and 6.

The results of the investigation are summarized in Figure 1. Impulsives scored lowest on the CPM under the standard testing condition (C_1). No differences between the impulsives and

FIGURE 1

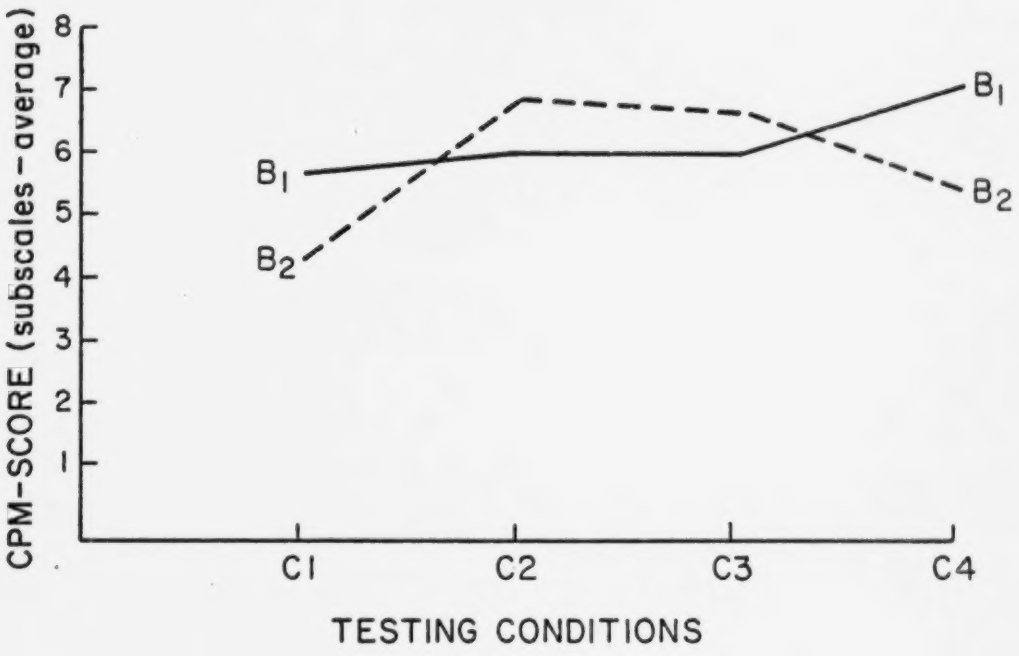
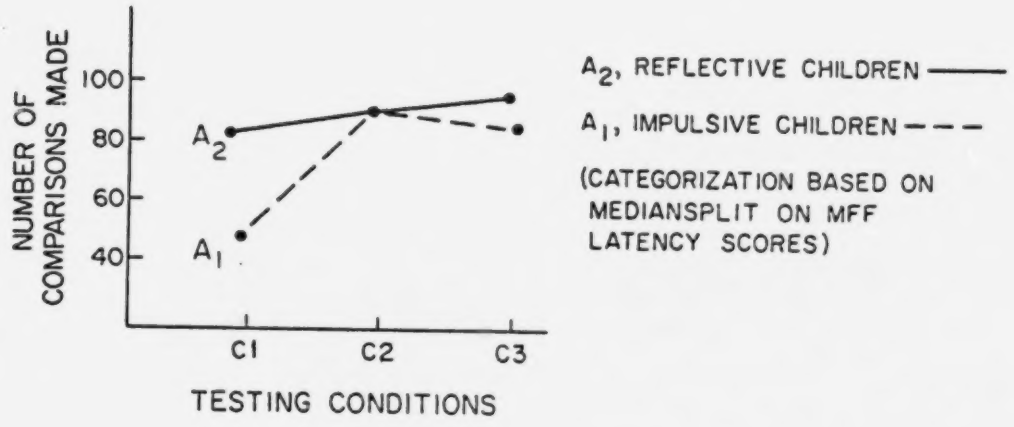


Fig. 1. CPM Performance of Reflective (B_1) and Impulsive (B_2) Children Under Different Conditions of Test Administration.

reflectives were detected under Conditions 2 and 5. That is, significant gains in performance were noted for the impulsives, but not for the reflectives when conditions of verbalization (C_2) and elaborated feedback (C_5) were employed. Under Condition 6, no compensatory effect was detected for the impulsive children.

In a study designed to ascertain how differences in test performance were reduced under the verbalization (C_2) and elaborated feedback conditions (C_5), Wiedl and Bethge (1980) analyzed eye movements for impulsive and reflective children defined by MFF latency scores. Several types of eye-movement measures were made. But regardless of eye-movement measures taken the same basic result was found: Under conditions of dynamic assessment, C_2 and C_5, the eye movement patterns of the impulsive and reflective children were about the same. Such was not the case with the Raven Matrices as administered under C_1. The following exemplifies the general findings.



1.2.4 Predictive Validity

Ultimately, the dynamic assessment approach and the results of the interaction between cognitive functioning and learning (personality) characteristics have to be related to an appropriate education for the child with learning disabilities. If such a match is achieved, predictive and construct validity will be established.

In a previous study (Carlson & Wiedl, 1976), differing patterns of correlations were detected between CPM performance obtained through modified testing procedures and measures of school achievement. From the perspective of ecological validity (Bronfenbrenner, 1979), it can be assumed that maximizing the predictor-criterion relationship can be achieved through a "match" between the conditions involved in test administration and the teaching methodology employed in a school subject area. It was hypothesized that optimizing testing procedures should yield maximum predictability for school performance when methods of adaptive teaching are used. On the other hand, test performance resulting from standard conditions of testing should be a good predictor of school achievement gained through "standard" teaching procedures, i.e., better than the prediction gained from scores obtained under optimizing testing conditions.

To test the hypothesis, the CPM was administered under the elaborated feedback condition (C_5) to 80 second-grade children (Wiedl & Herrig, 1978). The Cattell Culture Fair-Intelligence Test was used for standardized assessment of intelligence; the MFF as a measure of impulsivity-reflectivity. The school subject selected was

set theory. One-half of the children were taught set theory by means of the "normal" approach to teaching, i.e., teacher-oriented group instruction. The other half was taught by means of "adaptive teaching." For the adaptive teaching approach, the group of 40 was broken down into homogeneous groups of 5 to 7 children, matched in terms of intelligence and impulsivity. The teaching approach used in "adaptive teaching" was as follows: (1) For children of low IQ, the teaching procedure emphasized verbalization and scanning behavior. (2) For the high-impulsive children, the approach was designed to pace the children's behavior by the teacher demonstrating reflective, self-correcting approaches to the material.

As can be seen from inspection of Table 2, regression analysis yielded different patterns of relation between CPM performance and achievement as a result of the teaching methodologies involved. For the control group, the best predictor of school achievement was the CFT-1. For the experimental group, maximum prediction was achieved by the CPM (see Table 2).

Table 2

The prediction of achievement in set theory under conditions of standard and adaptive teaching with the help of dynamic (CPM; C_5) and a standardized intelligence testing (CFT-1)

Texts	Apaptive Teaching			Standard Teaching		
	a	b	f	a	b	f
CPM-learning test	$.55^{++}$	$.47^{++}$	.97	$.40^{++}$	.10	.54
CFT-1 intelligence	$.42^{++}$	.11	.57	$.53^{++}$	$.46^{++}$	.98

\+ $p < .05$

++ $p < .01$

a = Bravais-Pearson Correlation (r)

b = Standardized Beta-Weight

f = $\frac{r^2}{R^2}$; R = Multiple Correlation

It has been already established that some of the aforementioned characteristics can be modified in short-term laboratory interventions. (Readance & Bean, 1978). What has not been established is whether teachers identify inappropriate learning characteristics of the child with specific learning disabilities and design concomittant interventional strategies.

1.2.5 Summary

The approach of applying optimizing testing procedures to the normal population as well as to special groups of children was demonstrated. Restrictions and differentiations in the effects of

testing procedures, test format, and task demands were found. The applicability of certain testing procedures for purposes of assessing intellectual performance of normal and special school (learning handicapped, low IQ) children was shown. This indicates that specific forms of performance optimization can lead to more accurate, thus fairer, assessment of intellectual functioning. It was also demonstrated that specific dysfunctional individual characteristics such as impulsivity can be compensated for under certain testing conditions. This underscores the necessity of critically analyzing how variations in testing procedure can interact with certain individual differences. The implication here is that the practitioner must be aware of these interactions and under which circumstances performance may be increased for some children, while decreased for others.

Chapter II

Approach

2.0 Objectives

The basic objectives of the project were formulated to answer three interrelated questions addressing issues related to assessment of cognitive functioning and learning characteristics of children with specific learning disability:

1. Does the dynamic assessment approach yield information which is a more appropriate indicator of cognitive competence than that obtained by traditional, standard approaches based on static test theory?

   Corollary A: Do specific testing conditions differentially affect the performance of children with specific learning disability compared to children without overt learning disability?

If, as expected, the answer to the above questions is positive, the following questions become:

2. Why and for whom is the dynamic assessment approach effective? Stated differently: What are the sources of intraindividual variation, and how may they be accounted for by personality and cognitive style variables?

   Corollary B: Do children with specific learning disability differ on the assessed cognitive style and personality characteristics from children without specific learning disability?

The objectives involved in questions one and two are to examine task and subject variability, thereby uncovering and accounting for sources of individual variation in performance that usually remain ignored. This could lead the way to the use of standardized dynamic assessment approaches helpful in the identification of chidlren who are or may be classified as having a specific learning disability.

The third question addressed the issue of predictive validity and can be stated in the following way:

3. For what reasons should dynamic assessment procedures be employed?

This question involves two objectives. The first objective is to assess the impact of dynamic assessment on the very real problem of predicting school and curricular success. A related objective is to indicate to teachers, school psychologists, and others involved in teaching and curriculum development for children with specific learning disabilities, classroom approaches which will be most beneficial to specific pupils or defined groups of pupils.

2.1 Method

2.1.1 The Samples

The sample consisted of 229 fourth and fifth grade children from 15 elementary schools serving the San Bernardino, California area. The schools were selected from low, middle, and high SES areas in order to insure that the widest possible SES range would be inlcuded in the sample. There were 75 children with specific learning disability (51 males, 24 females), mean age 11:0, standard deviation 10

months; and 154 children with no specific learning disability (68 males, 86 females), mean age 10:6, standard deviation 10 months.

Due to unforeseen limited availability of fourth and fifth grade children classified as having specific learning disability, the sample is smaller than originally proposed. Nonetheless, we were able to obtain enough children with specific learning disability to make our sample large enough to carry out most of the analyses we had planned to do.

Within the specific learning disability and no specific learning disability categories, children were randomly assigned to one of three testing conditions. The following table gives the numbers of subjects in each condition.

	Test Condition			
Subject Sample	C1	C2	C3	Sum
SLD	25	25	25	75
No SLD	49	54	51	154
Total	74	79	76	229

2.1.2 Procedures

Due to the large amount of testing time required and the limited testing time available per testing session at most schools, a minimum of three sessions was required for complete testing of one subject. Total testing time per subject was approximately 2 1/2 to 3 hours. The majority of this time was used to administer the two tests of

cognitive and perceptual functioning: Raven's Matrices and the Cattell Culture Fair Test of "g." Each of these measures took approximately one hour to administer. Raven's Matrices were always administered before the Cattell CFT, and usually during the first session. Typical testing sessions were as follows:

Session 1	Session 2	Session 3
Ravens	Cattell	Harter Perceived
MFFT	Trail Making	Competence Scale
		Visual Search

All testing was done individually by trained graduate student testers. Specific administration protocols for each measure are presented below.

2.1.3 Measures of Cognitive and Perceptual Functioning

1. Raven's Matrices

Raven's Coloured Progressive Matrices (CPM) consists of three sections of 12 items each. Each item consists of a main stimulus pattern with a piece missing from the lower right hand corner. The subject's task is to select from the answer alternatives the correct "piece" that completes the main stimulus pattern. Factor analytic studies of the CPM have distinguished item groupings with different processing demands: simple pattern completion, pattern completion through closure, and concrete and abstract reasoning by analogy (Carlson & Jensen, 1980; Wiedl & Carlson, 1976).

Reliability and validity estimates of the CPM are generally reported to be high. Carlson and Jensen (1981) found the CPM to have equally high reliability for each of three ethnic groups: Anglo, Black and Hispanic Americans.

In this study, CPM items were supplemented by items from the Standard Progressive Matrices (SPM). The format of the SPM items is the same as the CPM items, although the items are not in color, and 8 answer alternatives are presented for the last three sections of the test (C, D and E). Section C of the SPM was administered after the CPM had been completed, making a total of 48 items. All 229 subjects completed the Raven's CPM and section C of the SPM. The test conditions and specific administration protocols association with them are presented below.

C_1 - Standard Instruction - The standard protocol set forth in the CPM manual (Raven, 1965) was used. The tester turned to the first problem in the test booklet (item A1), and pointed out to the subject the main stimulus pattern and noted that it had a piece missing from the lower right hand corner. The child's attention was then directed to the six answer alternatives below. He was told that only one of the six pieces was the correct piece to complete the pattern above. He was asked to say which one he thought was the correct one. If the child chose the correct piece, the tester replied "Yes, that's the right one," and explained why that was the right one and why the other five alternatives

were incorrect. If the child picked an incorrect distractor the tester said "No, that's not the right one," and pointed out the covered piece to the child. This was followed by an explanation of why it was the correct one, and why the one the child had picked was incorrect.

The child was then told to write down the number of the correct piece on his answer sheet, and that on each page of the booklet there was a similar problem. He was asked to work through the booklet by himself, and to write down the number of the piece he thought was correct in the appropriate place on his answer sheet. When the child completed the CPM, the tester showed him Section C of the SPM and told him that these were like the puzzles he just did, except that they were not in color, and he now had eight pieces to choose from. No further instruction or feedback was given to the child.

C_2 - Verbalization During and After Solution - The tester showed the child item A1 and asked him to describe the main stimulus pattern. The quality of the description is important and errors and inaccuracies were corrected. The child was then asked to choose the answer alternative below the pattern that he thought was the correct one to complete the pattern, and to explain why he thought it was the correct one. He was also instructed to "talk-aloud" about how he was solving the problem. For this sample item, the tester informed the

child if his choice was correct or incorrect, and why. The child was then instructed to work through the rest of the booklet, and to verbally describe to the tester the main stimulus pattern before making his choice as to the correct distractor. He was asked to always describe why he thought the alternative he chose was the correct one. After the first sample problem, the tester gave the child no feedback as to the correctness of his choice. The tester recorded the child's responses on an answer sheet. When the child finished the CPM, the tester showed him Section C of the SPM and told him the same thing told subjects in condition C_1.

C_3 - Elaborated Feedback - As in condition C_1, the tester showed the child item A1 and pointed out that the main stimulus pattern had a piece missing from the lower right hand corner, and that his task was to select from the six alternatives below the one which he thought was the correct one to complete the pattern. If the child chose the correct piece, the tester said "Yes, that's the right one'" and explain why it was correct. If the child chose the incorrect answer, the tester replied "No, that's not the right one," and explained why it was the incorrect response. He then pointed out the correct piece, and explained why it was the correct piece. This same procedure was followed for the remaining items, except that the experimenter did not point

out the correct piece if the child's response was wrong. The tester always made an effort to explain to the child the principles involved in the solution of the problem. Often, the child chose the correct response after the experimenter had explained the principles involved. However, in all three conditions, only the child's initial response was recorded by the experimenter.

2. Cattell's Culture Fair Test of "g" (Scale 2, Form A)

Cattell's CFT was administered in the second or third testing session, and under the same administration condition that Raven's Matrices had been administered. The CFT is composed of four subtests: "Series Completion" (12 items), "Classification" (14 items), "Matrices" (12 items), and "Conditions," or topological relations (8 items). The Series, Matrices, and Conditions subtests have 3 practice items each. The subtest Classification has two practice items.

The Cattell CFT is a well standardized, highly reliable intelligence test. Total scores on the CFT correlate moderately with other intelligence tests, including Raven's CPM.

The same general procedures for administration under standard, verbalization, and elaborated feedback conditions were followed. The tester worked through the practice items of each test with the child, and in all cases the child was informed if his responses on the practice items were correct, and if so why; and if not, why not.

Due to repeated absences, two SLD and three No SLD subjects did not receive the CFT.

2.1.4 Cognitive Style and Personality Measures

1. Matching Familiar Figures Test (MFF)

The MFF (Kagan et al., 1963) was used to assess individual differences in the cognitive style dimension "impulsivity-reflectivity." The test consists of 12 items. Each item has a picture of a familiar object, e.g., a house, and below the picture six answer alternatives, one of which is identical to the picture above. The subject's task is to point to the picture below which ("as quickly and correctly as you can") he thinks is the one identical to the picture. The tester records latency to the subject's first response, and the number of errors made on each item. Total test scores recorded for analysis were mean latency and total errors across all twelve items.

Often impulsive children are defined as those who are fast (latency below the group median), and who make many errors (above the group median). Conversely, reflective children are defined as being slow (latency above the group median) and making few errors (below the group median). Thus, a "double median split" on time and errors is usually performed to identify impulsive and reflective children. However, this procedure has methodological difficulties, and, in addition, results in a considerable loss of information. For analysis in this study, MFF time and error were treated as separate continuous variables. All 229 subjects completed the MFF.

2. Harter's Perceived Competency Scale for Children

The Perceived Competency Scale for Children is a measure of motivation recently developed by Harter (1979, 1982). The model upon which the scale is based is that the competence perceived by the child is an important factor in his/her intrinsic motivation to be effective, curious, prefer optimal challenge, and engage in independent mastery attempts. The scale assess four domains of perceived competence: (1) "Cognitive Competence," which emphasizes academic performance, (2) "Social Competence," which stresses social and peer group relationships, (3) "Physical Competence," which focuses on physical prowess, and (4) "General Self-Worth," which refers to being sure of oneself, being happy with the way one is, etc. The scales have been shown to have moderate to high reliability, and have been used with children 6 to 12 years of age.

Each domain consists of seven items. The experimenter read each item aloud to the subject. For example, one item from the Cognitive Competence domain is "Some kids often forget what they learn BUT other kids can remember things easily." The child is asked to decide if he/she is more like the first child described, or more like the second child described. Once the child makes this decision, he/she is asked if the description is "really true," or only "sort of true" for him/her. Each item is scored 1 to 4; the lower score reflecting greater perceived competence.

Due to repeated absences, one child (No SLD) was not given the Harter scales.

3. Trail Making and Visual Search Tasks

The Trail Making and Visual Search tasks are measures of planning ability. The role of planning and decision making in the performance of cognitive tasks has been established by Luria (1973), and expanded to include psychometric considerations by Das (1980). Good planning includes the following characteristics: (1) "looks before he leaps," (2) checking for errors, (3) taking all factors into account before making judgment, (4) evaluates feedback and acts accordingly, and (5) can generally come up with strategies to approach a problem. Das (1980) has found that planning ability affects cognitive performance, and that Visual Search and Trail Making are factorially independent from the impulsivity-reflectivity dimension.

The Visual Search task consists of 48 geometric shapes, letters and numerical sets. Due to limitations in testing time made available, a subset of 14 items was used. Each item is contained on a transparency. In the center of the transparency is a circle which contains an exact copy of the one "target" figure (or better or number) contained elsewhere on the transparency. The subject's task is to find and point to the figure which matches the one in the circle. The tester records the elapsed time for the subject to search the transparency and find the target figure (search time), and the time it takes for the subject to move his finger and point to that figure (movement time). However, the electronic timer used to measure movement time in this study was found to be erratic and unreliable, and movement times were not included in any of the analyses. That was not problematic, however, as search time is the most improtant measure on this task.

The Trail Making task presents the subject with stimulus sheets containing numbers and letters distributed randomly. The subject's task is to draw lines connecting the letters and numbers in the correct sequence, e.g., 1-A, 2-B, 3-C, etc. There are two parts to the test. The tester records with a stopwatch the elapsed time for the subject to complete each part of the test. Total time on both parts is recorded and used for analysis.

Due to repeated absences, the Trail Making task was not administered to one subject (No SLD). Complete and usable Visual Search data were collected on 137 No SLD subjects, and 64 SLD subjects.

2.1.5 Measures of School Achievement

In order to assess the predictive validity of the cognitive ability measures administered under the different test conditions, two measures of school achievement were obtained. These were standard scores on Reading and Mathematics from the California Test of Basic Skills (CTBS), administered in April, 1982. Reading test scores were available for 137 no SLD and 61 SLD subjects. Math scores were available for 134 No SLD and 59 SLD subjects.

2.2 Summary

A total of 229 fourth and fifth grade children participated in the study; 75 with Specific Learning Disability and 154 with no Specific Learning Disability. Measures of cognitive and perceptual functioning, impulsivity-reflectivity, motivation, and planning were administered. School achievement data in the form of CTBS reading and math standard scores were obtained.

Analysis of the data will address (1) the effect of testing conditions (static vs. dynamic) on Raven and Cattell scores; (2) the relationship of subject group classification (SLD vs. No SLD) to the personality/cognitive style variables and to Raven's and Cattell performance under the different test conditions; (3) the effects of "non-target" variables (impulsivity-reflectivity, motivation, planning) on Raven and Cattell performance under the different conditions, and (4) the "predictive validity" of the cognitive ability measures administered under standard vs. elaborative testing conditions.

Chapter III

Results

3.0 Organization

The results will be organized and presented in three sections. The first section will address (a) the effects of testing condition per se on Raven and Cattell performance, and (b) the relationship of learning disability to performance under the three conditions. The second section will address (a) the relationship between individual characteristics (impulsivity, motivation, planning) for the SLD and No SLD groups and (b) performance on Raven's Matrices and Cattell's CFT for each test condition. In the final section comparison of the predictive validities of Raven's Matrices and Cattell's CFT administered under the different conditions will be presented. In sections 3.1 and 3.2, Raven item groupings and the Cattell subtests will be treated as dependent variables in addition to the total scores on these two measures.

3.1 Relationship of test condition and learning disability classification to Raven's Matrices performance

Table 1 presents the means, standard deviations, and coefficient alpha (Cronbach, 1951) reliability estimates for total Raven Matrices scores separately by test condition and learning disability classification.

Table 2 presents the results of the 2 (learning disability classification) x 3 (test condition) analysis of variance performed on Raven total scores.

Table 1

Raven Matrices Total Score Means, Standard Deviations, and Internal Consistency (Coefficient Alpha) Reliability Estimates as A Function of Test Condition and Learning Disability

Subject Group	Test Condition								
	C_1			C_2			C_3		
	$\bar{X}$	SD	r_{kk}	$\bar{X}$	SD	r_{kk}	$\bar{X}$	SD	r_{kk}
SLD	33.4	6.0	.83	37.0	5.0	.78	35.5	4.0	.61
No SLD	34.7	6.1	.85	37.8	5.7	.85	35.1	5.2	.76

C_1 - Standard Administration; C_2 - Verbalization; C_3 - Elaborated Feedback; SLD - Specific Learning Disability; No SLD - No Specific Learning Disability

Table 2

Learning Disability (A) x Test Condition (B)

Analysis of Variance on Raven Total Scores

Source	df	MS	F
Learning Disability (A)	1	14.52	< 1
Test Condition (B)	2	195.70	6.50**
A x B	2	11.31	< 1
Error	223	30.10	

** $p < .01$

Inspection of Table 2 reveals a significant main effect only for test condition (B). The main effect for learning disability (A) and the A x B interaction did not approach statistical significance. Scheffe post hoc comparisons were performed to further analyze the significant main effect for test condition. These comparisons showed that performance under test condition C_2, verbalization, was superior to performance under C_1 (standard administration) ($p<.01$), and to performance under C_3 (elaborated feedback) ($p<.05$). Test conditions C_1 and C_3 did not differ significantly. Figure 1 graphically presents mean total Raven scores for SLD and No SLD subjects as a function of test condition.

The results of the learning disability x test condition ANOVA can be summarized as follows: Regardless of learning disability classification, Raven performance is highest under the verbalization test condition and lowest under the standard test condition. Elaborated feeback leads to only slightly higher performance than the standard administration condition. Mean scores for SLD and no SLD subjects differed by less than one point under the elaborative testing conditions (C_2 and C_3), and were only slightly different under C_1, where the no SLD subjects mean score was just under 1/3 of a standard deviation higher than the mean score for the SLD subjects.

The items of Raven's CPM were divided into two groups which have been shown to require different solution strategies: Pattern completion and closure items; and concrete or abstract reasoning by analogy items. The groupings were based on previous factor analytic

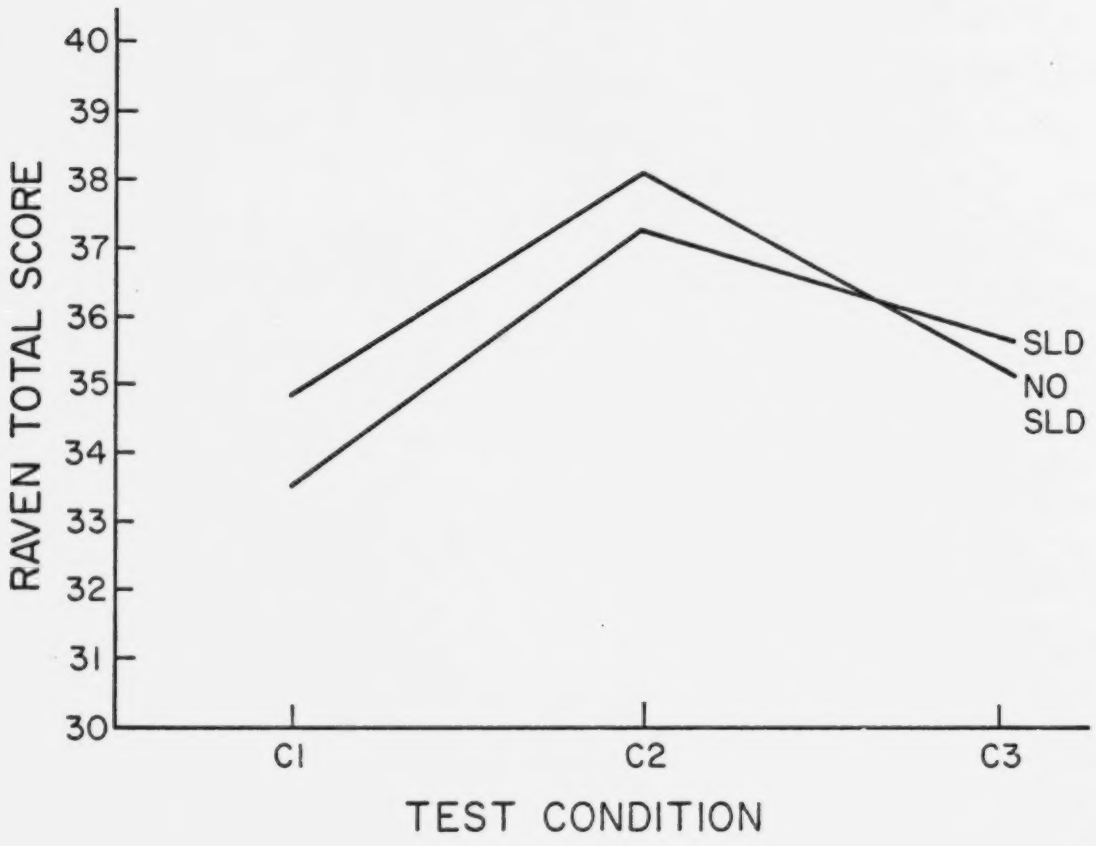


Fig. 1. Raven Matrices Total Scores as a Function of Test Condition and Learning Disability Classification

studies of the CPM (see Carlson & Jensen, 1980; Wiedl & Carlson, 1976). Section C of the Standard Progressive Matrices (SPM) was analyzed separately as a third subgroup of items. Means and standard deviations for the three item subgroups are presented in Table 3 for the test condition x learning disability group categories. Analyses of variance for these data are summarized in Table 4.

A significant main effect for learning disability was found on the resoning subgroup items. Significant main effects for test condition were noted on the pattern completion and reasoning subgroup items. Marginally significant ($p<.10$) effects for both learning disability and test condition were found on the Section C items. None of the learning disability x test condition interactions were statistically significant.

The significant main effect for learning disability in the absence of a significant learning disability x test condition interaction indicates that, across all test conditions, No SLD subjects had higher reasoning item mean scores than SLD subjects. Scheffe comparisons were performed within each test condition to determine the locus of the main effect for learning disability. However, the conservative Scheffe procedure did not indicate that the SLD and no SLD group means were significantly (i.e., $p<.05$) different within any one test condition. The lowest computed probabilities for the SLD/no SLD comparisons were for test conditions C_1 and C_2 ($p = .11$ and .16, respectively). This indicates that the significant omnibus F for learning disability can be attributed primarily to SLD and no SLD mean differences under these two test conditions.

Table 3

Raven Item Subgroup[1] Means and Standard Deviations as a Function of Test Condition and Learning Disability

Test Condition/ Item Group	Subject Group			
	SLD		No SLD	
	$\bar{X}$	SD	$\bar{X}$	SD
C_1				
Pattern Completion	15.3	2.1	15.5	1.8
Reasoning	2.0	1.8	2.6	1.7
Section C	6.1	2.5	6.7	2.3
C_2				
Pattern Completion	16.0	1.5	16.1	1.6
Reasoning	3.0	1.4	3.5	1.6
Section C	7.0	2.2	7.5	2.0
C_3				
Pattern Completion	15.5	1.5	14.9	1.8
Reasoning	2.8	1.4	3.1	1.3
Section C	6.9	1.7	7.2	2.0

[1]Item subgroups are composed of the following items: Pattern Completion (17 items): A2-A5; A7; A9; A10; AB2; AB4-AB8; B2-B5; Reasoning (16 items): AB10, B8-B12; Section C (12 items): C1-C12, Standard Progressive Matrices

Table 4

Summary Table for Results of Analyses of

Variance on Raven Item Subgroups

Source	Pattern Completion	Reasoning	Section C
Learning Disability (A)	ns	*	.088
Test Condition (B)	*	**	.054
A x B	ns	ns	ns

*F value significant, $p < .05$

**F value significant, $p < .01$

Scheffe comparisons were again performed to further analyze the main effect for test condition on the pattern completion and reasoning items. These comparisons are summarized in Table 5.

Table 5

Summary of Scheffe Post Hoc Comparisons for Test Condition on Raven Matrices Item Subgroups

	Item Subgroup		
Comparison	Pattern Completion	Reasoning	Section C
Test Condition	$C_2 > C_3$ ($p < .01$)	$C_2 > C_1$ ($p < .01$) $C_3 > C_1$ ($p < .05$)	X

Inspection of Table 5 will show that test condition C_2, verbalization, led to higher pattern completion scores than C_3 ($p < .01$) and higher reasoning item scores than C_1 ($p < .01$). C_3 also led to higher reasoning item scores than C_1 ($p < .05$). Since the omnibus F for test condition on Section C items was nonsignificant, no post hoc comparisons were performed on this item subgroup.

Figures 2 and 3 show the mean scores on the three item subgroups as a function of test condition and learning disability classification, respectively. They provide information about the

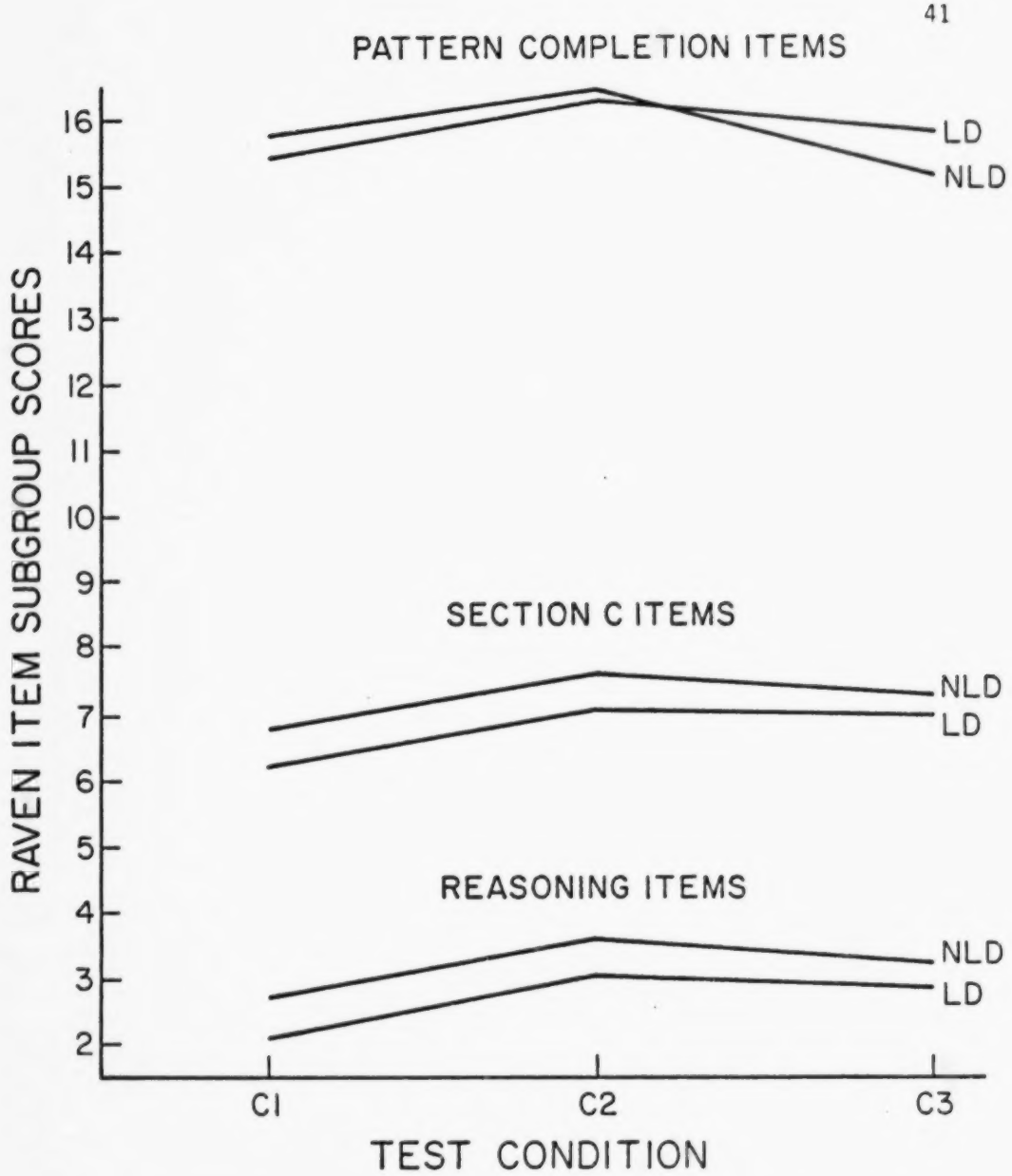


Fig. 2. Performance of SLD and no SLD Groups on Raven Matrices Item Subgroupings Administered Under Three Testing Conditions.

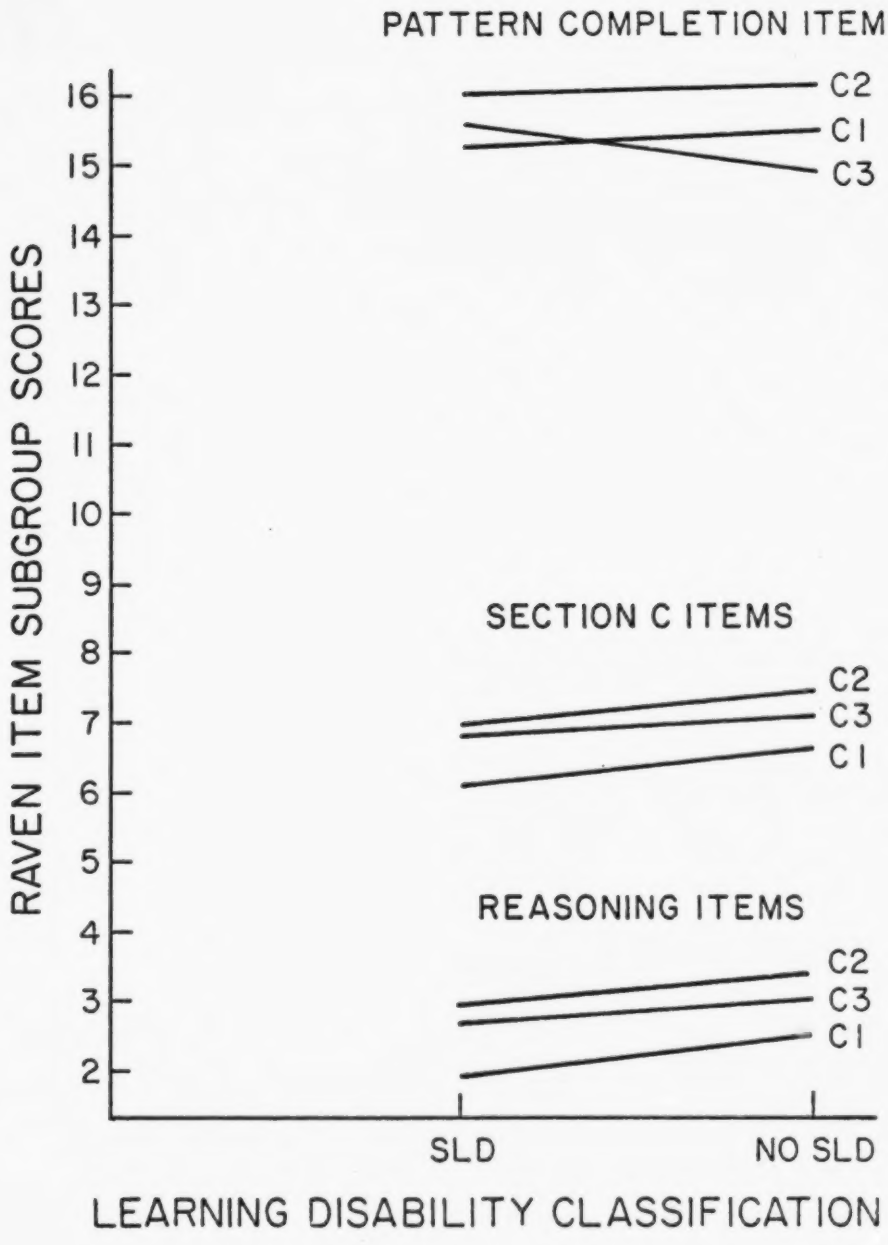


Fig. 3. Effect of Testing Conditions on Raven Matrices Item Subgroupings for SLD and No SLD Subject Groups

form of the data not revealed by the ANOVAS or the multiple comparisons. Specifically, they show that for the pattern completion items, performance is poorest under C_3 for the No SLD subjects. C_2 appears to be the most efficacous condition for all three item groups for both SLD and No SLD subjects.

When the results of the Raven item subgroup analyses are combined with the results of the analysis of total Raven scores, the following conclusions can be drawn concerning the relationship between learning disability, test condition, and Raven's matrices performance: (1) Regardless of item type or learning disability classification, the verbalization test condition leads to higher levels of performance than the standard administration procedure or the elaborated feedback condition. (2) Both elaborative conditions (C_2 and C_3) lead to enhanced levels of performance on the more difficult reasoning and Section C items for both SLD and No SLD subjects. However, elaborated feedback appears to "hinder" performance on the relatively easy pattern completion items for No SLD subjects, since performance on these items is actually lower than performance under standard administration procedures for this group.

3.2 Relationship of test condition and learning disability classification to Cattell's CFT performance

Table 6 presents the means, standard deviations, and coefficient alpha reliability estimates for total CFT scores spearately by test condition and learning disability classification. Inspection

Table 6

Cattell CFT Total Score Means, Standard Deviations, and Internal Consistency Reliability Estimates as a Function of Test Condition and Learning Disability Classification

Subject Group	Test Condition								
	C_1			C_2			C_3		
	X	SD	r_{kk}	X	SD	r_{kk}	X	SD	r_{kk}
SLD	25.2	3.5	.39	30.5	4.4	.64	27.0	3.7	.43
No SLD	27.2	5.6	.76	30.8	6.0	.81	28.0	5.4	.75

C_1 = Standard Administration; C_2 = Verbalization; C_3 = Elaborated Feedback; SLD = Specific Learning Disability; No SLD = No Specific Learning Disability

of Table 6 shows that the coefficient alpha reliability estimates for the SLD subjects are quite low, especially under test conditions C_1 and C_3. The estimates are low enough to question whether the use of these data in any analysis would produce meaningful and interpretable results. Fortunately split-half reliability estimates corrected using the Spearman-Brown formula are somewhat higher for the LD subjects, being .50, .72 and .71 for conditions C_1, C_2, and C_3, respectively. Nunally (1967) has suggested that reliabilities of .50 to .60 are adequate for basic research purposes.

Table 7 shows the results of the learning disability x test condition analysis of variance performed on total Cattell scores.

Table 7

Learning Disability (A) x Test Condition (B)

Analysis of Variance on Cattell Total Scores

Source	df	MS	F
Learning Disability (A)	1	58.41	2.18
Test Condition (B)	2	347.29	12.99**
A x B	2	11.54	<1
Error	218	26.74	

** $p < .01$

Inspection of Table 7 reveals results nearly identical to those reported in Table 2 for the ANOVA on Raven total scores. A significant main effect is noted only for test condition (B), whereas the main effect for learning disability (A) and the A x B interaction are not statistically significant. Scheffe post hoc comparisons indicated that performance under C_2 was significantly higher than performance under either C_1 ($p<.01$) or C_3 ($p<.01$). The difference in mean Cattell scores between C_1 and C_3 was not statistically significant. Figure 4 graphically presents mean total Cattell scores for the SLD and No SLD subjects as a function of test condition.

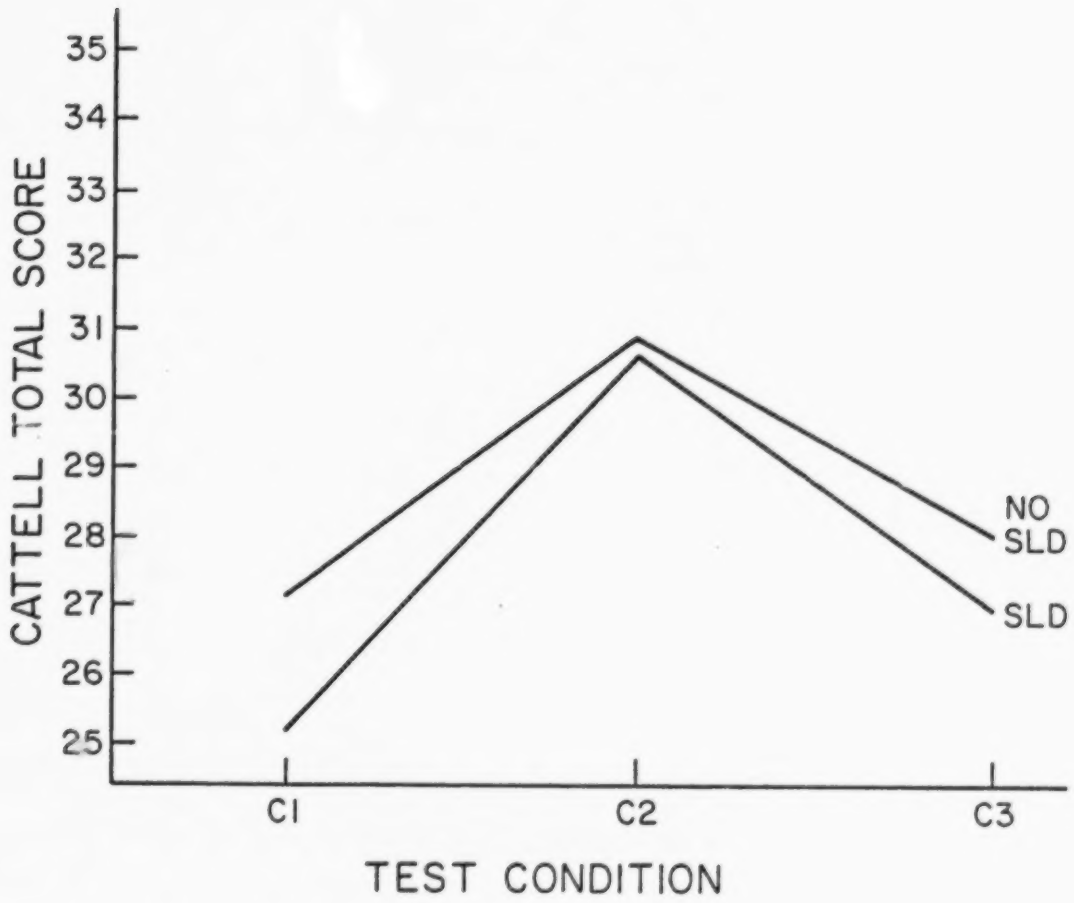


Fig. 4. Cattell CFT TotalScores as a Function of Test Condition and Learning Disability Classification

Each of the four subtests of the Cattell CFT was analyzed separately. The means and standard deviations on these subtests are presented for each test condition and for each learning disability classification in Table 8.

Table 8

Means and Standard Deviations for Cattell CFT Subtests as a Function of Test Condition and Learning Disability

Subject Group/ Test Condition	Cattell Subtest							
	Series		Classification		Matrices		Conditions	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
SLD C_1	7.7	1.3	6.4	1.4	7.1	2.1	4.0	1.6
SLD C_2	8.6	1.3	8.0	1.8	8.7	1.8	5.2	1.5
SLD C_3	7.9	1.5	7.0	1.5	7.7	1.7	4.5	1.7
No SLD C_1	8.1	2.0	6.8	2.0	7.8	1.8	4.5	1.9
No SLD C_2	8.5	2.1	7.6	2.1	9.0	2.0	5.7	1.7
No SLD C_3	8.0	1.8	7.2	1.9	8.3	2.0	4.6	1.7

Table 9 summarizes the results of the learning disability x test condition ANOVAS performed on the Cattell subtests.

Table 9

Summary Table for Results of Analyses of Variance on Cattell CFT Subtests

Source	Series	Classi-fication	Matrices	Conditions
Learning Disability (A)	ns	ns	.06	ns
Test Condition (B)	.07	**	**	**
A x B	ns	ns	ns	ns

** F value significant, $p < .01$

Inspection of Table 9 will reveal significant main effects for test condition on three of the Cattell subtests: Classification, Matrices, and "Conditions," or topological relations. A trend ($p = .07$) was found for series. The main effect for learning disability classification was not significant for any subtest, although a trend ($p=.06$) was detected for matrices with No SLD performance higher than that of the SLD group. None of the learning disability x test condition interactions approached statistical significance.

Scheffe post hoc comparisons were performed on those sub-tests for which there were significant main effects. These comparisons are summarized in Table 10.

Table 10

Summary of Scheffe Post Hoc Comparisons for

Test Condition on Cattell CFT Subtests

Comparison	Series	Classification	Matrices	Conditions
Test Condition	$C_2>C_1$	$C_2>C_1$ ($p\leq.01$)	$C_2>C_1$ ($p\leq.01$)	$C_2>C_1$ ($p\leq.01$)
	$C_2>C_3$ ($p<.10$)		$C_2>C_3$ ($p\leq.05$)	$C_2>C_3$ ($p\leq.01$)

The comparisons in Table 10 show that on the Classification item subtest, the verbalization test condition led to significantly higher performance levels than the standard administration procedure. On the Matrices and "Conditions" subtests, verbalization led to significantly higher performance levels than both the standard administration and ealborated feedback test conditions. A trend in this direction was also found for performance on Series. Standard administration and elaborated feedback were not significantly different for any subtests.

Figures 5-8 graphically depict performance on the four Cattell subtests as a function of test condition.

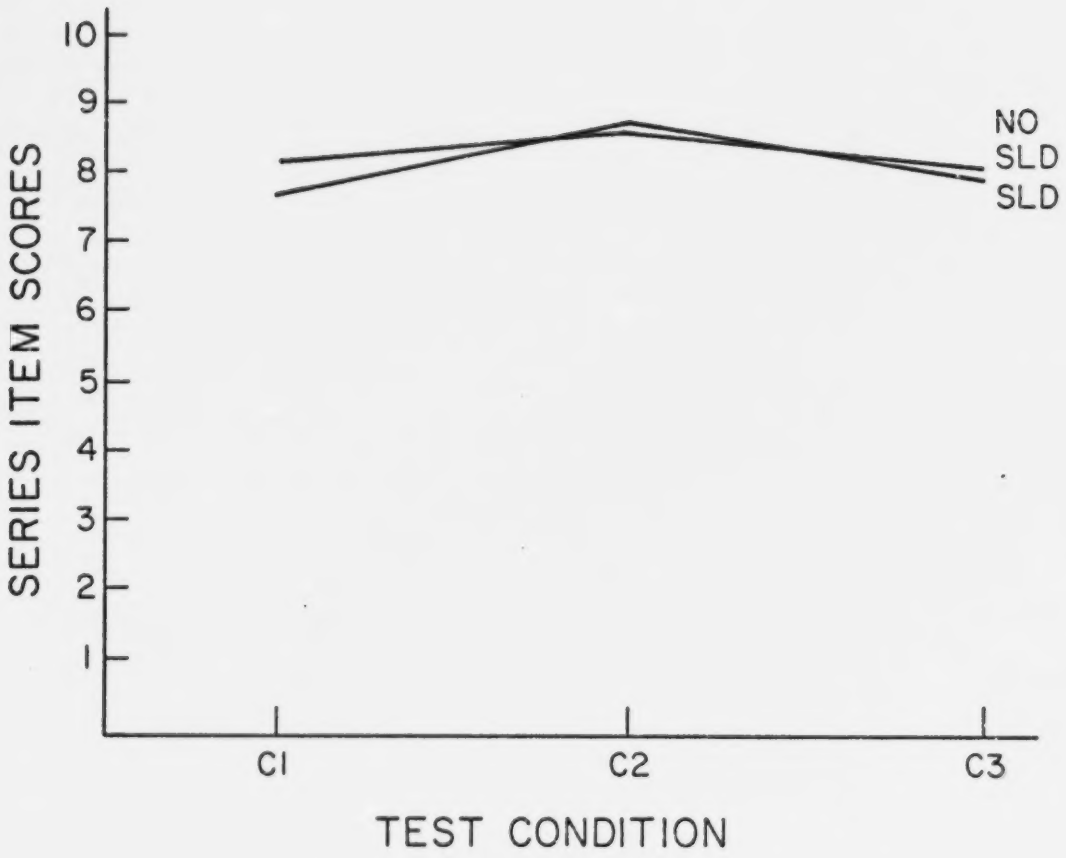


Fig. 5. Performance of SLD and No SLD Subject Groups on Cattell's CFT Series Completion Items Administered Under Three Testing Conditions

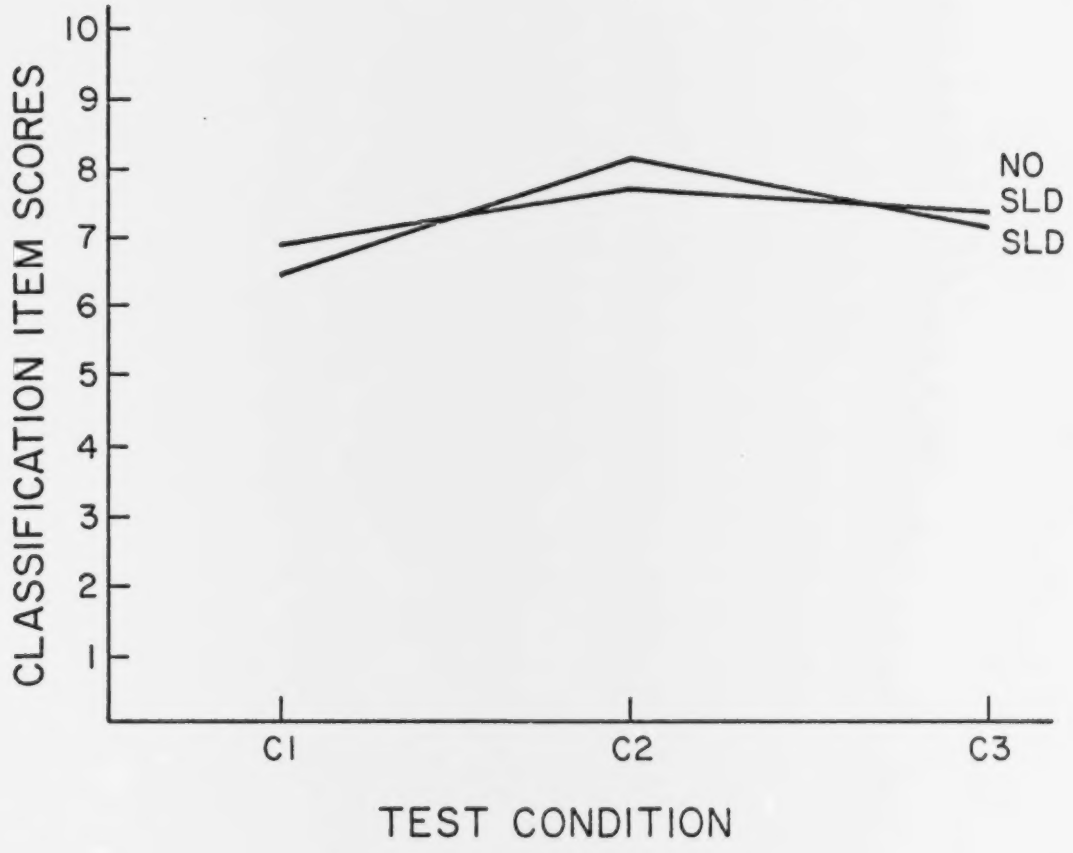


Fig. 6. Performance of SLD and No SLD Subject Groups on Cattell's CFT Classification Items Administered Under Three Test Conditions

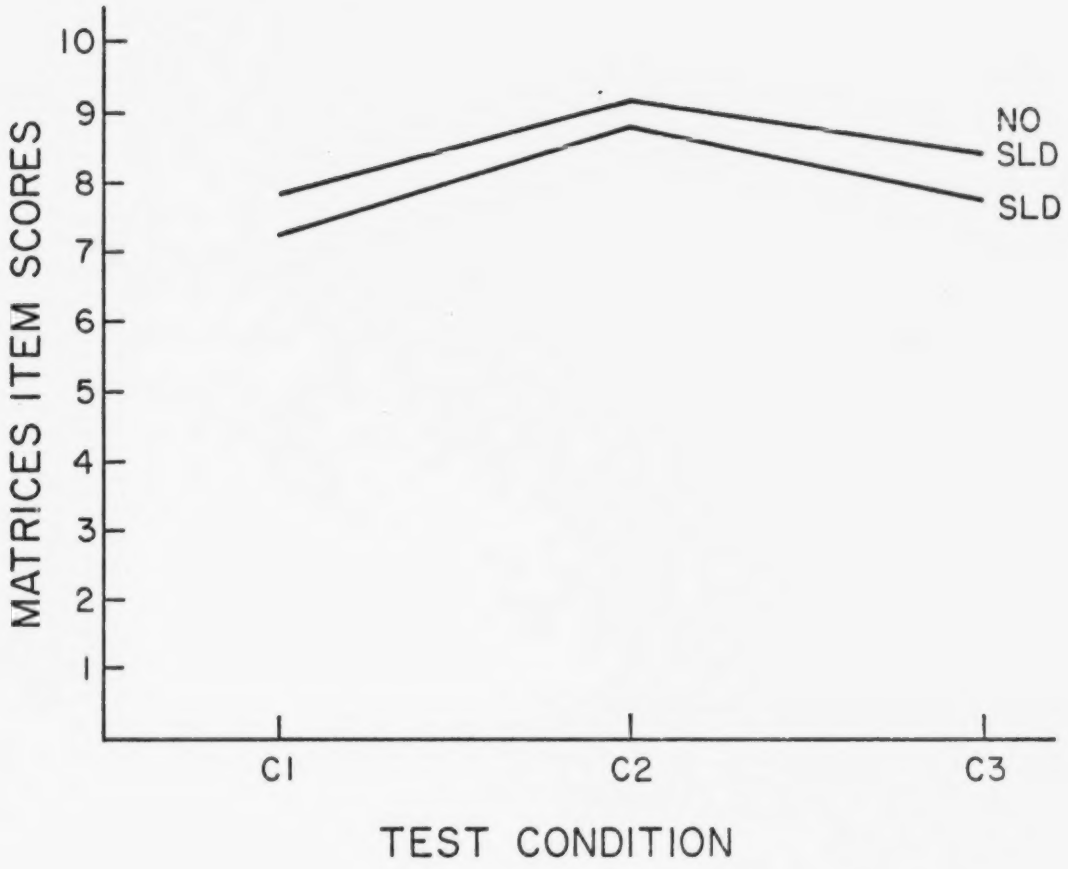


Fig. 7. Performance of SLD and No SLD Subject Groups on Cattell's CAT Matrices Items Administered Under Three Test Conditions

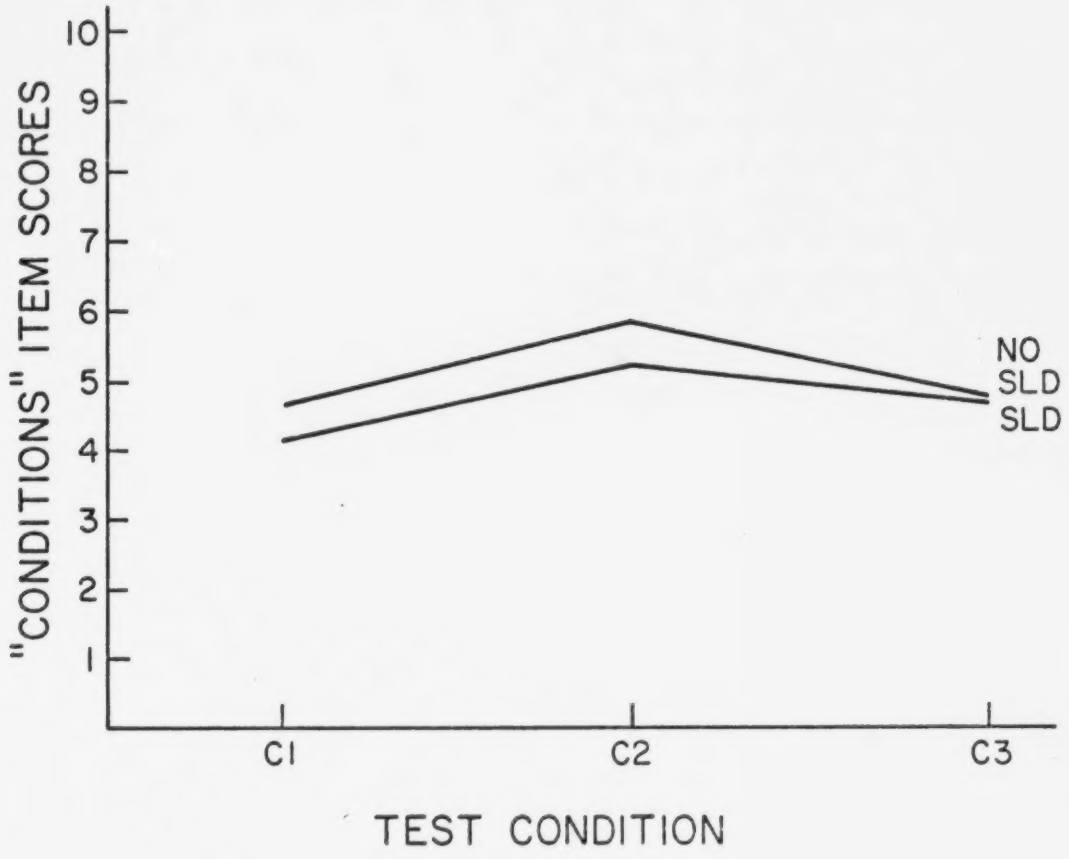


Fig. 8. Performance of SLD and No SLD Subject Groups on Cattell's CFT "Conditions" Items Administered Under Three Test Conditions

The analyses performed on the Cattell subtests indicate that the main effect for test condition is largely due to the facilitative effect of the verbalization test condition on performance for the Classification, Matrices, and Topological Relations items. As Figures 5-8 show, verbalization led to higher performance levels for both learning disabled and non-learning disabled subject groups.

3.2.1 Summary

The results presented in sections 3.1 and 3.2 can be summarized as follows: Significant differences in performance on Raven's Matrices and Cattell's CFT were noted. These were attributable to method of test administration and, for the reasoning items on Raven's Matrices, to learning disability classification. There was no evidence of interactive effects between learning disability classification and method of test administration. Analysis of the significant main effects revealed that Verbalization was the most effacious test procedure leading to the highest performance levels on both Raven's Matrices and Cattell's CFT. Additional analyses indicated that verbalization was especially effective in improving performance on the pattern completion and analogical reasoning items of Raven's Matrices, and on the Classification, Matrices, and Topological Relations items of the Cattell CFT.

3.3. The relationship of "nontarget" variables to performance on Raven's matrices and Cattell's CFT administered under standard and elaborative testing conditions

Analysis of the effects of impulsivity, planning, and motivation on Raven and Cattell performance will be presented in two stages. In the first stage, potential differences related to learning disability group classification on all the "nontarget" variables will be assessed by t-tests for independent samples. In the second stage, the "non-target" variables will be correlated with Raven and Cattell scores separately within each testing condition. For the "nontarget" variables which do not show significant learning disability group differences, the data will be combined for the correlational analyses. For the "nontarget" variables which do show significant learning disability group differences, the correlational analysis will be performed separately for the SLD and No SLD groups.

The t-tests and correlational analyses will address the following questions: (1) Do the learning disabled and non learning disabled groups differ on any of the impulsivity, planning, or motivational variables? (2) Do any of the impulsivity, motivational, or planning variables correlate significantly with Raven's matrices (or with Raven item subgroups) or Cattell's CFT (or with Cattell subtests)? (3) If some of these measures do correlate with Raven and Cattell performance, does the relationship hold for all test conditions? (4) If some of the variables are related to Raven's and/or Cattell performance under at least one test condition, are they variables

which were shown to be differentially related to learning disability classification?

3.3.1 Learning disability classification and measures of impulsivity, motivation, and planning

Table 11 presents the means, standard deviations, and sample sizes on all nontarget variables separately for the learning disabled and non learning disabled subject groups. Reliability estimates for the Harter Perceived Competence Scale were computed for the learning disabled and non learning disabled subject groups, and are presented in Appendix A. For each of the nine nontarget variables, t-tests for independent samples were performed. These results are summarized in Table 12.

Inspection of Table 12 indicates significant learning disability group differences on five variables: MFF errors, the Harter Cognitive Competence Scale, Trail Making, and the mean and standard deviation of the Visual Search planning task. The direction of these differences indicates that learning disabled subjects made more errors on the MFF Test, had lower perceived Cognitive Competence, took more time to complete the Trail Making task, and had longer and more variable Visual Search times than non learning disabled subjects.

Table 11

"Nontarget" Variable Means, Standard Deviations, and Sample Sizes for SLD and No SLD Subject Groups

Measure/Variable	SLD			No SLD		
	$\bar{X}$	SD	N	$\bar{X}$	SD	N
Impulsivity[1]						
MFFT	9.2	4.9	75	9.8	5.7	154
MFFE	12.2	5.0	75	10.2	4.3	154
Planning[2]						
TM	229	69	75	190	49	153
Mean VST	3.27	1.04	64	2.73	.73	137
SD VST	2.19	1.23	64	1.63	.75	137
Motivation[3]						
CC	19.3	4.3	75	15.3	4.1	153
SC	15.3	5.2	75	14.7	4.6	153
PC	16.9	4.8	75	16.3	4.6	153
GSW	15.3	4.8	75	15.1	4.1	153

[1]Impulsivity Variables: MFFT, Matching Familiar Figures Test, Time
-MFFE, Matching Familiar Figures Test, Errors

[2]Planning Variables: TM, Trail Making Time, Seconds
-Mean VST, Mean Visual Search Time, Seconds
-SD VST, Standard Deviation Visual Search Time

[3]Motivation Variables: CC, Harter's Cognitive Competence Scale
-SC, Harter's Social Competence Scale
-PC, Harter's Physical Competence Scale
-GSW, Harter's General Self Worth Scale

Table 12

Summary of SLD and No SLD Group Comparisons

On "Nontarget" Variables

Measure/Variable	df	t value	2-tail probability
Impulsivity			
MFFT	227	-0.80	ns
MFFE	227	3.10	<.01
Planning			
TM	226	4.81	<.01
Mean VST	199	4.26	<.01
SD VST	199	3.96	<.01
Motivation			
CC	226	6.88	<.01
SC	226	0.84	ns
PC	226	0.95	ns
GSW	226	0.39	ns

3.3.2 Correlation of "nontarget" variables with Raven and Cattell performance

Within each test condition, learning disabled and nonlearning disabled subject groups were combined and scores on the "non-target" variables on which these two groups did not significantly differ were correlated with Raven total score and item subgroups and with Cattell total score and the Cattell subtests (Tables 13 and 14, respectively). Separate correlations for the learning disabled and non learning disabled subject groups are reported in these tables for the five variables on which the groups differed significantly. For the sake of clarity of presentation, only statistically significant correlations are reported in Tables 13 and 14.

Inspection of Table 3 reveals that MFF Time is significantly related to Raven total score only under the verbalization test condition (C_2). However, the tendency to respond quickly as measured by MFF Time appears to affect performance on different item types depending on the method of test administration. Under standard testing conditions (C_1), "impulsive" children seem to perform poorly on the Pattern Completion items. Under the verbalization condition, this effect is noted for the Reasoning and Section C items, and for the elaborated feedback condition (C_3), the Reasoning items only.

MFF Errors are moderately negatively correlated with Raven total score under all three test conditions for the non learning disabled subjects, and are significantly related to Raven total scores only under standard administration procedures for the learning disabled

Table 13

Correlations between Nontarget Variables and Raven Matrices Scores
As a Function of Test Condition

	Test Condition											
	C_1				C_2				C_3			
Variable	Ravtot	PC	Reas	Sec C	Ravtot	PC	Reas	Sec C	Ravtot	PC	Reas	Sec C
MFFT	ns	.24*	ns	ns	.27*	ns	.24*	.38**	ns	ns	.27*	ns
MFFE (LD)	-.52**	ns	ns	ns	ns	ns	ns	ns	ns	-.44*	-.42*	ns
MFFE (NLD)	-.40**	-.41**	ns	ns	-.32*	ns	ns	-.40**	-.41**	-.33*	-.39**	ns
TM (LD)	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
TM (NLD)	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
$\bar{X}$ VST (LD)	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
$\bar{X}$ VST (NLD)	ns	ns	-.35*	ns	-.35*	ns	-.36*	-.42**	ns	ns	ns	ns
SD VST (LD)	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
SD VST (NLD)	ns	ns	ns	ns	ns	ns	-.43**	ns	ns	ns	ns	ns
CC (LD)	ns	.49*	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
CC (NLD)	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
SC	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
PC	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
GSW	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns

*p<.05
**p<.01

subjects. Again, the specific item groups related to MFF Errors appears to vary as a function of test condition. For the non learning disabled subjects, performance on the pattern completion items is related to MFF Errors under C_1; Section C items under C_2; and Pattern Completion and Reasoning items under C_3. For the learning disabled group, the effect of MFF Errors is approximately equally distributed among all three item groups under C_1, with Raven total score showing the only statistically significant correlation with MFF Errors. Neither Raven total score nor any of the item subgroups are related to MFF Errors under the verbalization condition; whereas both Pattern Completion and Reasoning items are significantly correlated with MFF Errors for the learning disabled subjects under the elaborated feedback condition.

Table 13 also reveals that, regardless of learning disability classification, Trail Making time is not significantly related to Raven performance under any test condition. However, several significant correlations are reported between the other two planning variables (mean and standard deviation of Visual Search Time) and Raven performance for non learning disabled subjects. Mean Visual Search time is shown to be significantly negatively correlated with Raven total score and with the Reasoning and Section C items under C_2 for this subject group; and significantly related to the reasoning items under C_1 for this group as well. The only significant correlation reported between the standard deviation of Visual Search Time and Raven's performance is with the reasoning items under C_2 for the non learning disabled group.

There appears to be little relationship between the motivation measures and Raven performance. Not surprisingly, the Social Competence, Physical Competence, and "General Self Worth" scales do not correlate with Raven total score or with any of the item subgroups under any test condition. The Cognitive Competence Scale has a single significant correlation, that being with the Pattern Completion items under C_1 for the learning disabled subjects. However, it is likely that this is a spurious correlation, since it is in the wrong direction. That is, the correlation indicates that individuals who have low perceived cognitive competence tend to have higher scores on the pattern completion items.

In summary, the impulsivity variables (MFF Time, MFF Errors) appear to have the strongest and most systematic relationship to Raven's performance, although the relationships do vary as a function of test condition and, for MFF Errors, learning disability classification. Among the planning variables, Visual Search Time is related to Raven performance under the verbalization test condition for the non learning disabled subjects only. The motivation variables show no interpretable relationship with Raven performance under any test condition.

Inspection of Table 14 reveals that MFF Time is not significantly related to Cattell performance under any test condition. MFF Errors are significantly related to Cattell performance under standard administration procedures for learning disabled subjects; and to Cattell performance under verbalization and elaborted feedback test

Table 14

Correlations between Nontarget Variables and Cattell's CFT Scores[1] as a Function of Test Condition

	Test Condition														
	C_1					C_2					C_3				
Variable	Cattot	S1	S2	S3	S4	Cattot	S1	S2	S3	S4	Cattot	S1	S2	S3	S4
MFFT	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
MFFE (LD)	-.44*	-.41*	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
MFFE (NLD)	ns	ns	ns	ns	ns	-.40**	-.34*	ns	ns	-.40**	-.43**	ns	ns	-.49**	-.38**
TM (LD)	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	-.43*	ns
TM (NLD)	ns	ns	ns	-.33*	ns	-.29*	-.33*	ns	ns	-.29*	ns	ns	ns	ns	ns
$\bar{X}$ VST (LD)	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
$\bar{X}$ VST (NLD)	ns	ns	ns	ns	ns	-.44**	ns	-.41**	-.39**	ns	ns	ns	ns	ns	ns
SD VST (LD)	ns	ns	ns	ns	ns	ns	ns	ns	-.53**	ns	ns	ns	ns	-.45*	ns
SD VST (NLD)	ns	ns	ns	ns	ns	ns	ns	-.32*	ns	ns	ns	ns	ns	ns	ns
CC (LD)	ns	ns	ns	ns	.48*	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
CC (NLD)	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
SC	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
PC	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
GSW	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns

[1]Cattot = Cattell Total Score; S1 = Series Completion Subtest; S2 = Classification Subtest; S3 = Matrices Subtest; S4 = "Conditions," or Topological Relations Subtest

*p<.05, **p<.01

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test conditions for non learning disabled subjects. MFF Error, then, seems to be the most sensitive predictor of both Raven and Cattell performance of the two impulsivity variables.

Trail Making appears to be related to Cattell performance, affecting primarily the performance of non learning disabled subjects under the verbalization condition. For the learning disabled subjects, Trail Making is significantly correlated only with the Matrices items of the Cattell administered under elaborated feedback conditions.

Visual Search time is primarily related to Cattell performance under the verbalization test condition, with mean Visual Search time correlating significantly with the Classification and Matrices item subtests for non learning disabled subjects. Neither the mean nor standard deviation ofVisual Search time is related to Cattell performance under standard administration procedures for either subject group. The standard deviation of Visual Search time is significantly correlated with the Matrices subtest for the learning disabled subjects under both verbalization and elaborated feedback conditions.

There is a similar lack of relationship between the motivation scales and Cattell performance as found between these scales and Raven performance. The only significant correlation found is between the cognitive Competence Scale and performance on the Topological Relations items for learning disabled subjects under standard administration procedures. However, this correlation, like the

one reported in Table 13 between the cognitive competence scale and Raven performance, is in the "wrong" direction.

3.3.3 Summary

The following summarizes the results presented in section 3.3, specifically with respect to the questions posed at the beginning of the section:

1. Significant differences between SLD and No SLD subject groups were found on five of the nine nontarget variables. These differences indicate that learning disabled subjects, as opposed to non learning disabled subjects, make more errors on the MFF Test, are poorer "planners" as measured by both the Trail Making and Visual Search tasks, and have lower perceived Cognitive Competence.

2. Of the three sets of nontarget variables, the impulsivity variables (MFF Time, MFF Error) show the strongest relationship to Raven and/or Cattell performance. Specifically, MFF Time is related to Raven performance, and MFF Errors to both Raven and Cattell performance.

3. MFF Time is related to at least one Raven item subgroup under all three test conditions, but predominantly affects performance under the verbalization test condition. MFF Errors is related to the performance of learning disabled subjects on the Raven under C_1 and Cattell under C_1 and C_3. The planning variables, Trail Making and Visual Search, appear to be related to Raven and Cattell performance primarily under C_2.

4. MFF Errors, Trail Making, and Visual Search appear to be differentially related to learning disbility classification group performance on the Raven and Cattell. As mentioned under (3) above, MFF Errors are related to Raven performance under all three test conditons for non learning disabled subjects, but only to performance under C_1 and C_3 for the learning disabled group. On Cattell's CFT, MFF Errors are related to the performance of learning disabled subjects only under C_1, and for non learning disabled subjects only under C_2 and C_3. Trail Making is not related to either SLD or No SLD group performance on Raven's matrices, but is related to the Cattell performance of non learning disabled subjects under C_2. The Visual Search measures are not related to the learning disability groups performance on Raven's matrices under any test condition, but do affect the performance of non learning disabled subjects on both Raven's and Cattell, primarily under C_2.

3.4 Predictive validity of Raven's Matrices and Cattell's CFT as a function of method of test administration and learning disability classification

We are concerned in this section with comparisons of the predictive power of the two measures of cognitive ability administered under the different test conditions. The criterion measures to be used are Reading and Math standard scores taken from the Comprehensive Test of Basic Skills (CTBS). The CTBS was administered during the Spring of the 1982 academic year. Beyond comparing the predictive validity of Raven's and Cattell as a function of test condition,

we are interested in finding out if predictive validity varies as a function of learning disability classification.

Our plan was: (1) To estimate and compare the predictive validity of Raven and Cattell as a function of test condition per se. Hence, correlations between the predictor and criterion measures were calculated for all subjects combined within each test conditon. (2) To estimate the predictive validity of Raven and Cattell as a function of test condition and learning disability classification. Correlations between the predictor and criterion measures were computed separately for the learning disabled and non learning disabled groups within each test condition. Comparisons were then made between the SLD and No SLD groups within test conditions, and within the SLD and No SLD groups across test conditons.

The analysis will allow us to address the following questions:

1. Regardless of learning disability group classification, does the predictive validity of Raven and/or Cattell vary as a function of method of test administration?

2. Is the predictive validity of Raven and/or Cattell different for learning disabled and non learning disabled subject groups?

3. Is the predictive validity of Raven and/or Cattell higher under a particular test condition for either learning disabled or non learning disabled groups?

3.4.1 Predictive validity as a function of method of test administration

Table 15 presents the Pearson product-moment correlation coefficients and their squared values between the predictor measures (Raven, Cattell) and the criterion measures (Reading and Math standard scores) separately for each test conditon. The SLD and No SLD groups are combined in the analysis.

Inspection of Table 15 shows that the correlation of both predictors with both criterion measures are statistically significant for all testing conditions. Within each test condition, Cattell's CFT predicts the criterion measures better than Raven's matrices; a single exception being the prediction of reading scores under C_2. Between test conditions, it can be seen that the predictive power of both Raven's and the Cattell is greater under one or both of the elaborative test conditions than under standard administration procedures. In terms of percentage of variance accounted for in the criterion measures by the predictor measures, the power of Raven's matrices to predict CTBS reading scores is over three times as great under C_2, and twice as great under C_3, as it is under C_1. Similarly, the CFT predicts reading scores approximately twice as well under C_3 as under C_1. A similar pattern is noted for the prediction of math scores. Raven predicts over twice as much of the variance in math scores under C_2 as it does under C_1. Similarly, Cattell predicts math scores almost twice as well under C_2 as under C_1.

Table 15

Pearson Product-Moment Correlations between Predictor Measures of Cognitive Ability and Criterion Measures of School Achievement (SDL and No SLD groups combined)

Test Condition/ Predictor	Criterion Measure: Reading r	Reading r^2 (%)	Reading n	Math r	Math r^2 (%)	Math n
C_1						
Raven	.22*	4.8	61	.31**	9.6	60
Cattell	.34**	11.6	61	.37**	13.7	60
C_2						
Raven	.41**	16.8	70	.47**	22.1	68
Cattell	.33**	10.9	69	.49**	24.0	68
3						
Raven	.32**	10.2	67	.35**	12.3	65
Cattell	.44**	19.4	67	.42**	17.6	65

*p<.05

**p<.01

3.2 Predictive validity as a function of method of test administration and learning disability classification

Table 16 presents the Pearson product-moment correlation coefficients and their squared values between the predictor and criterion measures as a function of test condition for learning disabled group.

Table 16 shows that neither Raven's matrices nor Cattell's CFT significantly predict reading scores under any test condition for the learning disabled subjects. Math scores are significantly predicted by Raven's under standard administration procedures, and by the Cattell under elaborated feedback conditions.

Table 17 presents the predictive validity coefficients for the non learning disabled sample. These coefficients, as opposed to those reported in Table 16, are much more consistent and amenable to interpretation. Inspection of this table will show that both the Raven and the Cattell tests significantly predict reading and math scores under all three test conditions. Within each test condition, Raven and Cattell predict the criterion measures approximately equally as well. Across test conditions, however, it can be seen that prediction is greatest under C_2 and weakest under C_1. Both elaborative test conditions appear to enhance the predictive validity of the cognitive ability measures for non learning disabled subjects.

Table 16

Pearson Product-Moment Correlations between Predictor Measures of Cognitive Ability and Criterion Measures of School Achievement Learning Disabled Subjects

Test Condition/ Predictor	Criterion Measure: Reading r	Reading r^2 (%)	Reading n	Math r	Math r^2 (%)	Math n
C_1						
Raven	.14	2.0	20	.54**	29.2	19
Cattell	.29	8.4	20	.25	6.3	19
C_2						
Raven	.15	2.3	22	.23	5.3	21
Cattell	-.11	1.2	22	.17	2.9	21
C_3						
Raven	.09	1.0	19	.34	11.6	19
Cattell	.16	2.6	19	.47*	22.1	19

*p<.05

**p<.01

Table 17

Pearson Product-Moment Correlations between Predictor Measures of Cognitive Ability and Criterion Measures of School Achievement Non Learning Disabled Subjects

Test Condition/ Predictor	Criterion Measure: Reading r	Reading r^2 (%)	Reading n	Math r	Math r^2 (%)	Math n
C_1						
Raven	.33*	10.9	41	.33*	10.9	41
Cattell	.35*	12.3	41	.42**	17.6	41
C_2						
Raven	.52**	27.0	48	.53**	28.1	47
Cattell	.49**	24.0	47	.58**	33.6	47
C_3						
Raven	.42**	17.6	48	.43**	18.5	46
Cattell	.50**	25.0	48	.43**	18.5	46

*p<.05

**p<.01

The results of the predictive validity analysis presented here indicate that, for the combined SLD/No SLD sample, both elaborative testing conditions increase the power of the meaures of cognitive ability to predict school achievement. However, when the data for the SLD and No SLD groups are analyzed separately, it is clear that the increase is primarily due to the enhanced predictive validity of the cognitive ability measures administered under the elaborative test conditions, particularly the verbalization condition, for non learning disabled children.

Chapter IV

Discussion

4.0 Organization

The objectives of the study were formulated to answer three interrelated questions. The results will be discussed as they pertain to each of the questions.

4.1 Research Question One

The initial research question was:

> Does the dynamic assessment approach yield information which is a more appropriate indicator of cognitive competence than that obtained by traditional, standard approaches based on static test theory?

The corollary of this question was:

> Do specific testing conditions differentially affect the performance of children with specific learning disability compared to children without overt learning disability?

The data concerning these questions are presented in detail in sections 3.1 and 3.2 of the previous chapter. They are quite similar for both the Raven Matrices and the Cattell Culture Fair Test. Regardless of the test employed, the testing condition which involved overt verbalization on the part of the child led to significantly higher levels of performance than evidenced under either the standard testing condition or the condition which involved elaborated feedback. The gains made by the learning disabled and non learning disabled groups were approximately parallel and equal. Accordingly, the answer to the first question is Yes, if the dynamic testing condition

involves subject verbalization more accurate information is gained concerning the child's cognitive competence than when a traditional testing approach is applied.

The positive answer to this question both assumes and implies that the levels of performance observed under the verbalization condition reflect more accurately the individual's "true ability" than the performance elicited through the standard or elaborated feedback conditions. "True ability" is, of course, something which cannot be measured. In behavioral terms it doesn't make much sense as it is a theoretical abstraction. Nonetheless, in the context of the competence performance distinction discussed in Chapter 1 it is useful. What was observed is that performance (a behavioral index) increased on rather complex cognitive tasks when the subject overtly described the task at hand as well as his approach in finding the solution. Since no tuition as such was involved, it would seem highly unlikely that the individual developed, on the spot as it were, new mental capabilities, abstract reasoning abilities which were not "there" in the first place. What seems to be involved is elaboration and application of existing capability similar to Vygotsky's description of the "zone of proximal development."

The role which verbalization plays in affecting performance is complex. Modifications in information processing are implicated. A particularly broad and useful model of information processing was outlined by Rubinstein (1977) and expanded upon by Lompscher (1975). In addition to structures and processes of information processing,

Lompscher has explicated the role which procedural characteristics play in thinking and problem solving. These involve characteristics which the individual brings to the problem solving situation. They include planfulness, exactness, self-regulation, flexibility, orientation, and level of activity or arousal. Although several aspects of Lompscher's model may be used to help explain the observed effects of verbalization, modifications in certain procedural characteristics seem most parsimonious and plausible. For example, it would appear likely that overt verbalization leads to increased planfulness in approaching the task to be solved. Individuals who can plan well, although don't consistently do so in a traditional testing situation, should demonstrate improved performance under the verbalization condition. (This will be discussed as the second research question is addressed.) Overt verbalization could also lead to increased self-regulation or monitoring of one's behavior as well as greater exactness, a component which Feuerstein (1982) has demonstrated to be affected through appropriate use of language.

Support for modifications which verbalization brings about in these components has been offered by some recent eye movement studies (Dillon & Stevenson-Hicks, 1981; Bethge, Carlson, & Wiedl, 1982). These investigations demonstrated that subjects who used overt verbalization while solving perceptual and analogical reasoning tasks used more systematic and complete stimulus scanning patterns than subjects who did not overtly verbalize. The authors concluded that increased planfulness and exactness were developed.

Although the learning disabled children tended to perform slightly less well than their non learning disabled counterparts on the Raven and Cattell, the differences were not significant. In fact, the only point where a statistically significant difference was approached was under the standard testing condition on the Cattell Culture Fair Test. There appear to be essentially no differences in abstract reasoning ability between the two groups of children studied. Accordingly, the answer to the corollary of question 1, concerning potential differential effects of dynamic assessment on the learning disabled and non learning disabled groups, is negative. The testing conditions did not differentially affect performance of the two groups. On the contrary, both groups tended to benefit approximately equally under the overt verbalization condition, with neither group benefitting from elaborated feedback. Although there are marked differences between the learning disabled and non learning disabled groups on school achievement, it would appear that differences in cognitive functioning do not account for the discrepancy. Other, essentially noncognitive, factors are implicated.

4.2 Research Question Two

The second research question was formulated in the following way:

> Why and for whom is the dynamic assessment approach effective? Stated differently: What are the sources of intraindividual variation, and how may they be accounted for by personality and cognitive style variables?

The corollary of this question was:

Do children with specific learning disability differ on the assessed cognitive style and personality characteristics from children without specific learning disability?

The data concerning these questions are presented in detail in section 3.3 of the previous chapter. The second question and its corollary shall be discussed together.

4.2.1 Impulsivity

The learning disabled group made significantly more errors on the MFF than did the non learning disabled subjects. No significant difference between the groups was found for the time score on the MFF, however. Traditionally, a double median split is used on both the time and error scores to arrive at the categories "impulsive" - "reflective." Our approach was to keep the dimensions separate as (a) the terms have no generalized meaning as the differentiations are made within a sample tested, and (b) using only two of the four quadrants would have reduced the sample size (especially for the LD group) to the point where statistical comparisons would be less powerful.

The finding that learning disabled children make more errors on the MFF is not new. When viewed in conjunction with the results concerning the learning disabled - non learning disabled comparisons on the Cattell and Raven, it can be put into a more general perspective, however. The poorer performance of the learning disabled group is apparently not due to cognitive or perceptual deficits. Other factors would appear to be involved. One of these may relate to the approach which the learning disabled children took to the problem. It may be

that their approach was lacking in exactness and planfulness (this will be discussed shortly). Although response latencies need not be affected, it has been shown (Wagner, & Cimiotti, 1975) that "impulsive" children tend not to use systematic and complete visual search strategies when solving MFF tasks. Similarly, Bethge and Wiedl (1981) demonstrated that individuals with high error rate on the MFF also use incomplete and unsystematic scanning strategies when solving tasks on the Raven Matrices.

For the samples involved in this investigation, error, not time, appears to be a significant dimension of individual and group difference. This suggests that the learning disabled children may not need to be "slowed down" in order to improve performance; rather, they may need to be made to be more accurate. One wonders what the effect of overt verbalization on MFF performance would be for this group. The evidence suggests that verbalization leads to compensations in certain procedural characteristics such as exactness and planfulness. If incorporated in the MFF and other more meaningful tasks, higher levels of performance should result.

The interactions between "impulsivity" and performance on the Raven and Cattell are inconsistent. One exception to this is for total Raven and Cattell scores for the learning disabled group. Under standard testing procedures significant correlations were found between the cognitive measures and MFF errors. These correlations were significantly reduced under the effective elaborative condition, verbalization. In other words, under C_1, those learning disabled

individuals who had high error scores tended to do less well on the Cattell and Raven than those individuals who had lower error scores. When the Cattell and Raven were administered under the verbalization condition, error score on the MFF did not correlate significantly with test performance. This indicates that compensations were brought about by overt verbalization. Those factors which relate to high MFF error, perhaps such as lack of exactness, no longer seemed to play a role in Raven and Cattell performance.

4.2.2 Planning

Significant differences between the learning disabled and non learning disabled groups were detected on all the planning variables used in the study. Variability in Visual Search may be related to attentional factors as will be discussed later. The results on the other indices show that the learning disabled children have, on the average, significantly higher latencies on the Trail Making and Visual Search tasks, indicating that the learning disabled group has poorer planning ability than the non learning disabled group.

Planning appears to be central to problem solving. Das (1983) has suggested that "The process of planning will underlie such activities as the generation, selection, and execution of a plan or program, evaluation of one's own behavior and that of others, and the response tendency to act on the basis of such evaluation." More specifically, Barron (1978) indicates that poor planning leads to at least three limitations in task performance. These are (a) failure to use appropriate strategies, (b) inadequate proficiency, and (c) limited capacity.

The general results of this study lead to the conclusion that the poorer planning ability of the children with specific learning disability is not related to limited capacity or inadequate proficiency; rather, the failure to use appropriate strategies is more likely involved.

Previous work has shown that even college students who are poor planners do not modify their problem solving approaches very substantially when given feedback concerning performance on cognitive tasks. Hence poor planning ability does not appear to be susceptible to modification (improvement) through indirect or "weak" intervention such as feedback or verbalization. It would be expected, therefore, that the elaboration conditions used in this study would not have compensatory effects for poor planning on performance on the Raven or Cattell. On the contrary, what would be expected is that those individuals who already have "good" planning ability would profit from the efficaceous dynamic assessment approach; those with poor planning ability, such as for SLD group would not.

The results supported this expectation. It was found that Trail Making and Visual Search time were not correlated with non learning disability group performance on the Cattell under standard administration conditions. By contrast, significant correlations were detected under the verbalization condition. This suggests that for the no SLD group, those individuals who were good planners were the gainers in the elaborating condition. Similar results were found for the Raven Matrices except that Trail Making did not appear to be a significant

variable. By way of contrast, no differential relations were found between the planning variables and the Raven or Cattell under different test administration conditions for the learning disabled group, a group with relatively poor planning ability. This suggests that the compensations in Raven and Cattell performance noted for the SLD group are not related to planing as much as exactness and greater self-regulation.

In short, a significant area of difference between the learning disability group and the non learning disability group is in planning. The types of compensations used, i.e., verbalization, while leading to improved Raven and Cattell performance for those who are good in planning do not compensate for poor planning ability. Other interventions appear to be necessary.

As was mentioned above, significant differences were found between the SLD and no SLD groups in variability on the Visual Search task. It would appear that attentional processes are involved as recent research (Carlson, Jensen, Widaman, 1983) has shown that variability in reaction time, and Visual Search is a reaction time type of measure, and attention are fairly closely correlated. Accordingly, these findings are consistent with previous work which has shown certain attentional deficits in children with specific learning disability.

4.2.3 Perceived Competence

The Perceived Competence Scale for Children assesses childrens' self-assessments of competence in three areas. Cognitive

competence emphasizes academic performance, being smart, and feeling satisfied with one's own classroom performance; social competence involves how one feels vis-a-vis one's peers, being liked, etc.; and physical competence focuses on how one assesses his/her performance in sports, games, etc. In addition, the scale includes a general self-worth measure. This assesses general self-esteem of a person independent of specific judgments of the three competencies described above.

The only significant difference detected between the learning disabled and non learning disabled children was in perceived cognitive competence. The learning disabled chidlren did not view their levels of competence in the other area or their general self-worth differently from the non learning disabled children. These findings are heartening as they suggest that the learning disabled children realistically appraise a problem they have, i.e., difficulty in classroom performance. At the same time they do not appear to have a negative self image in areas which do not involve academic pursuits.

4.3 Research Question Three

The third question guiding the research asked:

> For what reasons should dynamic assessment procedures be employed?

This question encompasses both theoretical and pragmatic dimensions. On the theoretical side, it would appear that the dynamic assessment involving verbalization does yield more accurate information concerning the assessment of cognitive ability than the traditional psychometric approach. These results have already been discussed under research questions one and two. On the pragmatic side

two questions are involved: Does the efficaceous dynamic assessment procedure yield more useful information concerning the prediction of school success? And, What implications can be drawn from the results for teachers and school psychologists as they work with learning disabled chidlren?

4.3.1 Prediction of School Achievement

The correlations between the Raven and Cattell and CTBS reading and mathematics scores tend to increase when the cognitive measures are administered under the verbalization condition. The increase is due to increased predictive power of the Raven and Cattell for the non learning disabled group. However, for the lerning disabled youngsters, the Raven and Cattell correlations with the achievement measures remain low regardless of testing condition. Although the restricted range of performance of the SLD group on the CTBS contributres to the low correlations, the levels of relationship are so low, that it would appear that neither the Raven nor Cattell have much utility for predicting learning disabled pupils' performance on standardized achievement measures.

The results previously noted indicate that the two groups do not differ significantly in perceptual and abstract reasoning ability. Verbalization led to higher levels of performance for both groups, although different compensations appeared to be involved. It was argued that the improved performance reflects increased accuracy of assessment, bringing performance indices closer in line to cognitive competence. But the question arises why the predictive power of the

cognitive measures increases under verbalization for the no SLD group but remains low for the LD group.

A plausible answer is that the children in the learning disability group have had a long history of academic problems. Though noncognitive factors seem to be implicated, the result is the same, poor performance on traditional school curriculum and tests. Performance on the mathematics and reading subtests of the CTBS is no exception. Accordingly, and in contrast to the children without learning disability, the rankings of learning disabled children on the standardized achievement tests will not correspond at all closely to their rank order on tests of cognitive functioning, regardless of how accurately the latter is assessed. Should interventions yield improvements in school performance related noncognitive factors, one would expect the correlations between cognitive abilities and school achievements to increase. That in fact should be the goal of any intervention program.

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APPENDIX A

Internal Consistency (Coefficient Alpha) Reliability

Estimates for Harter Perceived Competence Scales

Subscale	LD (N=75)	Non LD (n=153)
Cognitive	.64	.62
Social	.72	.68
Physical	.68	.72
General	.69	.62

APPENDIX B

Values Plotted in Figures

Fig. 1:

	C_1	C_2	C_3
SLD	33.4	37.0	35.5
No SLD	34.7	37.8	35.1

Fig. 2:

SLD	15.3	16.0	15.5	(Pattern Completion
No SLD	15.5	16.1	14.9	Items)
SLD	6.1	7.0	6.9	(Section C Items)
No SLD	6.7	7.5	7.2	
SLD	2.0	3.0	2.8	(Reasoning Items)
No SLD	2.6	3.5	3.1	

Fig. 3:

	SLD	No SLD	
C_1	15.3	15.5	(Problem Completion Items)
C_2	16.0	16.1	
C_3	15.5	14.9	
C_1	6.1	6.7	(Section C Items)
C_2	7.0	7.5	
C_3	6.9	7.2	

Fig. 3 (Cont.)

C_1	2.0	2.6 (Reasoning Items)
C_2	3.0	3.5
C_3	2.8	3.1

Fig. 4	C_1	C_2	C_3
SLD	25.2	30.5	27.0
No SLD	27.2	30.8	28.0
Fig. 5			
SLD	7.7	8.6	7.9
No SLD	8.1	8.5	8.0
Fig. 6			
SLD	6.4	8.0	7.0
No SLD	6.8	7.6	7.2
Fig. 7			
SLD	7.1	8.7	7.7
No SLD	7.8	9.0	8.3
Fig. 8			
SLD	4.0	5.2	4.5
No SLD	4.5	5.7	4.6